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A. W. ALLEN, *Editor*

ESTABLISHED 1866

VOLUME 129, No. 10

New York, May 23, 1930

How Much Does Sickness Cost the Employee?

HOW MUCH does the industrial worker's family spend for sickness during the year? How much for the care of the teeth? For the care of the eyes? How much for medicine, nurses, hospital care, operations? These are important questions, the Committee on the Cost of Medical Care asserts in a report just issued. They must be answered before any forward steps can be taken toward improving health service in the United States. From an industrial standpoint, the questions are particularly vital. If industry is to operate with increasing efficiency, improvement must be made in decreasing not only the prevalence and degree of sickness among employees but also the severe financial burden that illness frequently imposes on the victim. To this end, some plan must be evolved whereby the employee and his family can obtain adequate medical and surgical treatment at all times, under a method of financing that will not tax unduly the income of the family.

The initial step toward the evolution of such a plan has been taken by the Committee on the Cost of Medical Care. It has compiled, with the aid of a large insurance company, a record of a six months' survey of such expenditures made by 3,281 workers' families, consisting of 17,129 persons. The record was prepared from entries made by the respective families on monthly charts that were distributed by nurses of the insurance company. Some of the more important facts disclosed by the survey are:

1. Nearly every family had to make some expenditure for medical services during the period. Among the 3,281 families, consisting of 17,129 persons, only 198 families reported no expenditure.

2. The total amount disbursed by all families was $230,907, an average expense of $70 per family for six months, or $140 estimated for a complete year.

3. A large share of this outlay fell upon a small proportion of the families; 64 per cent of the total amount was expended by one-fifth of the total number of families.

4. Private physicians received the largest share—43 per cent of the total amount expended. But if expenditures for the care of teeth, care of eyes, and extra household disbursements are excluded, this ratio for physicians amounts to 54 per cent. One-fourth of all the money went for medicines and hospitals, about an equal share for each.

5. Eighty-two per cent of the families used the services of a private physician and 83 per cent needed medicines during this period. Thirty per cent of the families reported expenses for care of teeth and 9 per cent for care of eyes. Hospitals were used by 15 per cent of the families. More than one-third of the families reported extra household expenses as a result of sickness or injuries.

6. Families that had the services of a private physician paid him an average of $37 over a period of six months. Those that required hospital care paid an average of $60 for this service, and those that had operations paid an average of $74 for this special service.

7. Members of large families cannot afford to pay as much for medical care as can those of smaller families. Persons living alone paid out an average of $75.63 in six months for medical care, whereas those in families of nine or more persons paid out only $6.64 during the same months.

The committee, in its report, calls attention to the fact that the nurses who collected the data for the report operated in thirty-five states, generally in the smaller cities and towns, where nursing associations were absent. The results obtained, therefore, should reflect conditions throughout the United States fairly well. From the compiled data one fundamental conclusion is clearly evident—that sickness is a hazard of life comparable to other hazards, such as premature death and accident. Insurance against the latter is available, and loss of wages as a result of illness may be covered by insurance in many countries. The cost of medical care apparently must be financed by similar methods. When sufficient information is available concerning the cost of sickness, actuarial calculations to evolve suitable insurance programs can be made. These financial calculations are comparatively simple. The real problem, as the Committee on the Cost of Medical Care points out, will be to provide systematized medical service that will be adequate in the broadest sense. This is, in the last analysis, a problem for the medical profession, and one that must be given early consideration.

Tri-State Metallurgists Sponsor Nomenclature Reform

MANY have been the aspersions cast at the Tri-State zinc and lead district for a provincial nomenclature that has survived since the inception of mining operations there. True enough, some of the criticisms have been made by those who subsequently were proved to be "living in glass houses." Partiality toward a technical patois has prevailed in other mining localities as well. But, with-

out question, the Tri-State field has been outstanding in its devotion to a strange nomenclature of local origin. This loyalty, if it may be so called, has been the cause of much confusion, a confusion that has reacted to the disadvantage of the district and the high attainments of its technicians. For this reason, if for no other, the current endeavor of the recently formed association of Tri-State metallurgists to bring about the adoption of recognized milling terms, or the use of terms in their generally recognized meanings, should receive approval and elicit hearty co-operation.

To add that the association's effort will be indorsed outside the boundaries of the Joplin-Miami area is, perhaps, to append the self-evident. So much labor and difficulty have been involved in preparing manuscripts from the district for publication that editors cannot refrain from expressing their best wishes for the success of the association's efforts. If all the hours had been recorded that editors have spent in changing the words "dirt" and "ore," as used in manuscripts pertaining to Tri-State operations, to "ore" and "concentrate," respectively, the impressive total would provide another reason for a reform that recognizes the value of uniformity and the merits of simplicity in technical language.

Phosphate Exporters Lose Ground in Foreign Markets

TWO DECADES AGO, the exportation of phosphate rock from the United States was criticised as prodigal. At a time when the soil of the country's once rich farm lands was being rapidly impoverished, said the critics, one of the principal commodities that might be used in restoring its fertility was being sent abroad in steadily increasing quantities. Continental nations, more alive to the necessity of renewing the soil's fertility, were said to be profiting by our lack of foresight.

In their appraisal of the importance of phosphate as a fertilizer these zealots were correct. Reserves have proved larger than was dreamed, perhaps, but none too large, if the vital character of phosphate be considered. An estimate of the reserves of Florida, the leading producer since 1894, shows them to be still important. Those of the other Southern phosphate states—South Carolina, Tennessee, Kentucky, Arkansas—are placed by Mr. B. L. Johnson (in a paper recently issued by the United States Bureau of Mines) at approximately 113,000,000 tons, of all kinds and grades. In Idaho, Wyoming, Utah, and Montana exists about 6,000,000 tons, says Mr. Johnson, though much larger estimates have been made. On the whole, the United States' reserve of phosphate-bearing materials is of generous proportions.

The drain upon it is large, however. Since 1906, domestic production has ranged between 2,000,000 and 3,500,000 tons a year, the lean years of the War excepted, as well as 1920, when the output went over the 4,000,000-ton mark. Only a modest amount has been imported, ranging from 12,000 to 29,000 tons annually in the seven years before the War, and from 2,700 to 28,000 tons per year between 1920 and 1927. In the following year, 45,000 tons came in, attributable to sudden offerings from Cuba and French Morocco.

Before the War, exports were expected to show a steady increase, in addition to an anticipated greater domestic consumption resulting from growth of population. They had been rising swiftly. From 570,948 tons in 1898 they reached 1,018,212 in 1907, and in 1913 exceeded 1,366,000 tons. Checked by the War, they fell to a quarter of this amount or less in the latter years of the conflict, remaining at this low level until 1920, when they again passed the million mark. This increase they failed to hold, however, the tonnage thereafter falling short of seven figures by margins varying from 80,000 to 250,000. Statistics show the cause of this to be the increased production of Tunisia and Algeria. Although new markets were gained by United States producers, as in Italy and South Africa, old ones were lost, in some degree at least, in Germany, France, and Spain.

To some it may seem lamentable that the growth of the phosphate-mining industry of North Africa should hold down the exports from the United States to something around a million tons or less per year. How much better it would be (think they) if reserves abroad were scant, so that the mines of the United States might show an ever-increasing production with succeeding years. But far-sighted conservationists will be prone to look upon the inroads made in the export field by African phosphate as a national blessing in disguise. Even though solicitude for future generations with respect to many minerals may easily become ridiculous, the rapid squandering of phosphate reserves by exportation may well be frowned upon. Of phosphate it may be said without fear of contradiction that our children, and theirs, in turn, will need it. In various guises it will appear on the table of the American household at every meal. No substitute need be feared, nor will substitution be attempted. So long as Dame Nature uses phosphate of lime for building the human skeleton the demand for phosphate will be perennial.

The Andys in Mining

"WHAT'S the 'propolition'?" With these words Andy, of radio fame, invariably notifies his unseen but vast audience that he is about to become involved in another "sure-lose" venture, from which he will emerge "regusted" but not cured.

The world is full of "Andys." Many of them appear to have a decided preference for "investing" their money in questionable mining ventures. They are by no means ignorant, as is evidenced by the large number of professional men—doctors, lawyers, dentists, ministers—who yearly exchange some part of their earnings for attractive-appearing but worthless stock certificates.

Many of the Andys who contribute so blindly are men of standing in their professions. They have achieved prominence and success by the application of thought, skill, and judgment. When in doubt concerning the best procedure to adopt in solving a difficult problem, they seek the counsel of a colleague, knowing that the advice given will be reliable and the outcome beneficial. And yet, these are the men who are "angels" to innumerable ill-advised and invariably hopeless ventures in the field of mining. Thoroughly trained and experienced in their own professions, they rush into another field, woefully

or wilfully blind to the fact that mining is a profession requiring training and skill. They fail to realize that reputable mining engineers possess knowledge acquired in the same manner as their own has been, and that the problems they must solve are as difficult and require the same study, consultation, and advice as those found in other professional fields.

Do the members of these other professions know that such specialists as geologists, mineralogists, metallurgists, and mining engineers exist, qualified by training and experience to render reliable opinion and advice? Is the fact realized that these men of technical training maintain their existence, raise families and educate them, buy automobiles, and pay lawyers, doctors, and dentists with money received in compensation for advice and services rendered in connection with geological, mining, and metallurgical operations?

If they do not know these facts, why not? And, if they do know them, why do they continue to encourage hopeless or "million-to-one" ventures in mining and allied fields without first availing themselves of expert advice —the same type of advice they seek from colleagues in their own professions?

One might remark, with apologies to Andy, "I'se regusted."

A Mining Company Should Make the Most of Its Resources

OF THE packing industry some one is reported to have said that it utilized everything of the pig except the squeal, and even that was recorded by the phonograph. In this almost ancient anecdote some mining companies might find a hint leading them to review their practice, to see what chances to make an extra profit they have overlooked. How much of their "pig" do they turn to profit? Has all waste been eliminated? Are byproducts being utilized? The answers to these questions are to be found in the tailing pile and slag dump, in the solutions run to waste, in the dust produced, and in the gases passing to the stack.

A few companies display remarkable thrift in this respect. An outstanding example is that offered by a well-known enterprise east of the Rocky Mountains. Compared with the large-scale operations of the West, it produces a modest tonnage. Its ore is a massive sulphide mixture, comprising principally copper, iron, zinc, and sulphur. Its copper and sulphur have long found their way to market as blister and acid, respectively. The sulphur furnishes most of the fuel in smelting. Flotation has enabled the company to ship the iron, after sintering, to a convenient furnace. Similarly, its zinc would have been disposed of had the zinc market been maintained. Its slag dump is gradually being mined for ballast and road material. And its fine flotation tailing has been used to some extent for construction purposes. Were it not for the zinc—with which it is temporarily marking time—this operator might be said to be using even the "squeal" of its figurative pig. One wonders if sooner or later the hole left by the extraction of the deposit will be exploited for its inherent scenic qualities. Needless to add, the company's operations have been profitable.

Can the Low-Grade Gold Ore Deposit Be Exploited?

ON ANOTHER PAGE of this issue we publish an interesting and suggestive letter from Mr. Paul T. Bruhl, well known to readers of *Engineering and Mining Journal,* who discusses the problem of the economical treatment of low-grade gold ore—of special concern now that production is declining.

Mr. Bruhl's comments prompt consideration of many fundamental requisites to success. He draws attention, and rightly, to the futility of what he terms "useless grinding" of valueless gangue. As *Engineering and Mining Journal* recently quoted from a warning issued over a decade ago, this comminution is so applied in the cyanidation of some gold ores that "every particle of worthless rock and absorbent colloid is thoroughly accepted in as rich a solution of gold as possible."

The scope for greater attention to concentration, or to the discard of tailing before the major extraction step is practiced, is being realized, but the practice might be applied to low-grade ores to a much greater extent than it is at present. Mr. Bruhl recommends that amalgamation be avoided in the treatment of a low-grade gold ore. This calls to mind a suggestion, published in this magazine in 1923, that bulk leaching might prove profitable if applied to one low-grade domestic ore known to exist in immense quantities. The hint provoked adverse comment, and evidence was adduced to show that all-cyanidation had been tried a quarter of a century before. But the critic overlooked the fact that in the meantime the technique of bulk leaching had been advanced to such an extent that a mountain of discolored stone in Chile, sold "for a song," had been transformed into the greatest copper mine in the world. Perhaps, as one engineer averred, the hesitancy in making a move that would indicate a change in method of attacking the low-grade gold-ore problem has been due to lack of capital. As Mr. Bruhl says, an inertia in regard to the mining and treatment of such ore, despite the few but successful examples of initiative that would stimulate emulation, must be faced and overcome.

The opportunity for significant discovery by means of research is not past. Mr. Bruhl gives evidence that, in one type of gold-ore pulp, heating to the boiling point of water prior to chemical treatment may increase extraction. This should promote speculation and suggest further investigation with other ores. Much of the trouble experienced in metallurgical treatment has been due to the refractory physical characteristics of the colloid present. The fact has been well known that colloidality is destroyed by high temperatures. Roasting of ore prior to sliming insures greater permeability of the mass. Moisture in final residue is lower from a roasted ore than from an unroasted one, and mechanical extraction rises proportionately. No thorough research appears to have been done on the minimum amount of heat required to destroy the plasticity of clay and thereby increase the permeability of a clay mass.

On the broad question of economics, some problems must be assumed to be capable of solution as the work proceeds, if intelligent research is applied and ample capital provided. Many years of operation are usually needed to reach economic and technical success in the handling of low-grade ores, as the metallurgical histories of Alaska Juneau and Chuquicamata testify.

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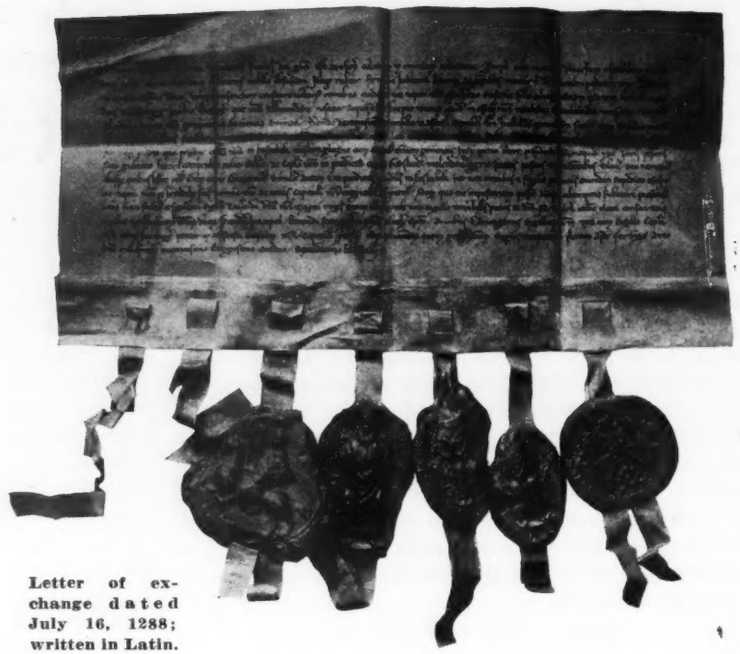


Letter of exchange dated July 16, 1288; written in Latin.

THE old copper mine at Falun, Sweden—in the Middle Ages the most important copper producer in Europe—has been worked for nearly 700 years. Documental evidence dates back to July 16, 1288, when a letter of exchange was issued to Bishop Peder of Västeras, who acquired one-eighth interest in the mine. On Feb. 24, 1347, the local operators, joint owners with the State, obtained a royal charter, which also contained rules governing mining operations and relations between owners and workmen. Both these documents are still in the possession of the company, in a museum built near the original mine.

After centuries of prosperity a great cave-in took place on Midsummer Day in 1687, which fortunately caused no loss of life, as the miners were all having a holiday. All machinery and equipment, however, were destroyed. From that time the mine lost its prominence, and is at present producing only pyrites for the company's cellulose plants, and a small tonnage of copper and zinc. The total estimated production to date is 500,000 tons of raw copper.

The Avesta copper refinery was built in 1641, producing sheets and coins. Some of these coins were of enormous size and are eagerly sought by collectors. The largest specimens still in existence are exhibited in the company's museum.

As the reserves of copper ore became exhausted, the company gradually developed the iron mines of Central Sweden and is today an important producer of iron and steel. It has also extensive forests, originally acquired for the production of charcoal; cellulose factories, power plants, and railroads. Ranking among the largest industries of Sweden, "Stora Kopparbergs Bergslags Aktiebolag" points with pride to a long and colorful history as the oldest industrial corporation in the world.

Photographs and data courtesy of Swedish American News Exchange

The great pit of Falu mine, with the city of Falun in the background

Computing Drill-Hole Data in Placer Prospecting

William W. Avery

WITHOUT attempting to compare the evaluation of placer ground and that of lode deposits, one may safely say that the former has involved a greater amount of controversy in recent years than the latter without anything like the same accord being reached by engineers.[1] Whereas, different engineers are likely to follow more or less the same procedure and arrive at approximately the same conclusion in considering data relative to prospecting a lode deposit, no such uniformity of method prevails as to the treatment of data obtained in the prospect drilling of a placer deposit. This variation in the method of computing the drill-hole data is particularly marked in the selection and method of applying a drive-shoe factor to be used in computing the tenor shown by the amount of metal extracted from the drill hole. This factor, varying with the size of the drive shoe, is the theoretical length of drive required to cut a sample containing a given quantity, usually 1 cu.yd. of material. Obviously, this factor must be regarded as theoretical only, or perhaps one had better say approximate, it being evident that the drive shoe is not a keen-edged instrument which cuts a core of uniform size, and the material sampled is not a homogeneous mass capable of being bored in this manner. It therefore follows that the best that can be attained is the use of a factor which, coupled with other considerations, will result in approximately accurate sampling. The accuracy of the sampling with its accompanying calculations is determinable finally only after the ground is exhausted, but the engineer is confronted with the problem of estimating probable returns in advance, for which purpose his only guide is obtained from his own and others' experience in exploiting similar deposits.

The variation in the factors used by different engineers for the same sizes of pipe and drive shoe is so wide as to suggest that somebody must be wrong. For the 7½-in. drive shoe of the standard Keystone drill, the 100 factor is widely used, this corresponding to the Radford factor of 27, but variations of as much as 100 per cent from this are nevertheless not uncommon. For the drive shoe of the Empire hand drill the factor is likely to be anything from 238 to 400. Similar discrepancies exist as to other sizes and types, the percentage variation being naturally greatest in the smaller sizes.

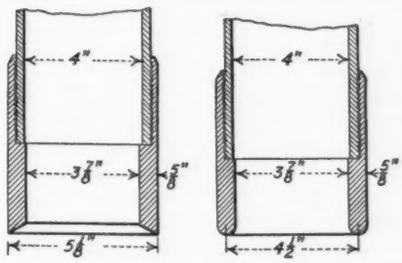


Fig. 1—(Left), A new drive shoe commonly used with a hand rig employing 4-in. casing. Fig. 2—(Right), The same shoe when worn.

The fact is that the result of computation of a factor based on the size of the drive shoe is subject to wide variation which depends on the judgment of the one who makes the computation and on the varying condition of the shoe itself as a result of wear during service. The accompanying Figs. 1 and 2 show a drive shoe commonly used with a hand rig employing 4-in. casing. Fig. 1 shows the condition of the shoe when new; Fig. 2 that after it has been in service. In the course of drilling, all shoe conditions between the two extremes are met.

For the shoe in Fig. 1, basing the calculation on a cutting diameter of 5⅛ in., one arrives at a theoretical factor of 188, on which basis it is common practice to use a factor of 200, this, in part, compensating for the initial wear of the shoe. By the time the shoe is worn to the condition shown in Fig. 2 (4½-in. cutting diameter) a theoretical factor of 243 is attained, which is still further increased if consideration be given to the fact that this condition of the shoe augments the tendency to crowd material out of rather than into the pipe. Similar data are applicable to other sizes of drive shoe, it being evident that the larger the shoe the smaller the percentage variation. From which it follows that the drive-shoe factor, although used as a constant, is actually not a constant but a variable, and that, if possible, other data should be used, to the end of reducing or attempting to reduce it to a constant.

In the search for drill-hole data that can be used in conjunction with and to correct for the discrepancies involved in the factor accepted for the drive shoe, are available (1) the measurement of the core in the tube after each drive, and (2) the measurement of the material after it is pumped from the casing.

On the whole, I believe that core-measurement data afford a better basis for adjustment than those obtained from measuring the material after it is pumped from the casing. In the latter there is always the question of variation in swell, loss in slime, and difficulty of accurate measurement. On the other hand, the core that rises in the pipe can be measured with reasonable accuracy at a time when it has been subjected to the minimum disturbance or change from its original state in the ground. Furthermore, one has a right to assume that, aside from the occasional unfortunate occurrence of pumping below the

By introducing core-measurement data into his calculations, Mr. Avery eliminates the vagaries otherwise resulting from inability to choose the drive-shoe factor that is exactly correct for all conditions.

[1]For the preparation of much of the data on which these notes are based I am indebted to my assistant, Mr. E. I. Brown.

Table I—Sample of Drill Log From Land Drilling, in Which Core Is Deficient

Depth of Pipe	Depth of Drive	Core Rise	Colors 1	Colors 2	Colors 3	Material
11.5	11.5	6.6	..	..	..	Soil and sand
13.0	1.5	4.5	..	..	..	Dirty gravel and sand
15.0	2.0	1.5	..	..	..	Boulder, gravel, and sand
17.0	2.0	0.7	..	..	..	Gravel and sand
18.0	1.0	0.6	..	..	..	Boulder, gravel, and sand
19.0	1.0	0.9	..	..	..	Gravel and sand
20.0	1.0	1.1	..	3	4	Boulder, gravel, and sand
21.0	1.0	0.8	..	3	9	Clay, gravel, and sand
22.0	1.0	0.4	..	2	3	Sand and gravel
23.0	1.0	0.7	..	..	2	Sand and gravel
25.0	2.0	4.9	..	..	..	Sand
27.0	2.0	2.6	..	1	2	Gravel and sand
27.5	0.5	0.9	..	..	..	Soft clay, bedrock

(Penetrated bedrock 0.5 ft.)

Depth overburden..... 11.5 ft.
Depth gravel..... 15.5 ft.
Depth to bedrock..... 27.0 ft.

$$\text{Constant} = \frac{200}{\text{Depth}} = \frac{200}{28.0} = 7.14$$

Grains gold in hole, 0.713. Grains gold per cubic yard, (0.713×7.14), 5.09.

Adjustment on core data: (computing distance from 19 to 27.5 ft.)
Drive, 8.0 ft.
Rise, 7.1 ft.
Desired rise, 1.62×8.0=12.96 ft.
Core factor, 12.96 ÷7.1=1.82

Grains gold per cubic yard: (200÷28)×0.713×1.82=9.26

Note: Depth for computation is taken at 28.0 ft., it being assumed that dredge will dig one foot of bedrock.

bottom of the shoe, the material which enters the casing is that which constitutes the sample and that the use of a factor without the interpolation of core measurement data is wrong in so far as the amount of core fails to check with the factor. Such a check is impossible ordinarily, the amount of core varying between wide limits, depending on the character of the gravel, amount of ground water, skill and carefulness of the driller, and other factors.

From the core data, within the limits of accuracy with which it is obtained, one is able to secure a correction figure capable of reducing the drive-shoe factor from a variable to a constant. To illustrate, consider both the 200 factor and the 243 factor for the same drive shoe, and, for the moment, disregard the question of swell of the core as and after it enters the tube.

The interior area of the pipe (Figs. 1 and 2) is 12.57 sq.in. The area of the drive shoe corresponding to the 200 factor is 19.44 sq.in. Now, to determine the theoretical core rise for a given drive:

Drive : Rise :: 12.57 : 19.44

Therefore, for a 1-ft. drive the theoretical rise is 1.54 ft.

For the 243 factor a corresponding drive-shoe area is 16 sq.in., the area of the interior of the pipe remaining the same. From which the following proportion is ascertained:

Drive : Rise :: 12.57 : 16

Therefore, for a 1-ft. drive the theoretical rise is 1.27 ft.

Now, if one introduces into the calculation of the value of the ground as indicated by drill-hole data a factor resulting from the ratio of the actually measured core to the theoretically desired core, it is evident that the discrepancy due to different factors for the same shoe is eliminated, inasmuch as

200 : 243 :: 1.27 : 1.54

It can hardly be assumed that the introduction of the results of core measurements into the calculation of the drill-hole data will give the final answer as to recovery expectancy. However, the introduction of these data does eliminate variations due to erratic cores; tends to co-ordinate the metal recovered with the material constituting the sample; and in the consideration of a given area or set of areas, tends to reduce the drill-hole data to a common basis for the various holes involved. The results afford equitable basic figures to which may be applied such recovery factor or factors as experience under the same or similar conditions indicates.

In the study of recovery from several dredged areas there has been developed the fact that without using the core data the relation of expectancy and recovery curves is distinctly erratic. The introduction of the core data into the expectancy calculations has, in every case, shown a marked tendency to bring these curves into parallel positions.

Speaking of results obtained with the 4-in. hand rig, the fact has been demonstrated that in areas of fine to medium gravel in which the maximum size of boulders is rarely up to head size, with the average more nearly fist size, the cores will be deficient as compared with the desired cores computed on the basis of the factor used. This is true even where the gravel is fairly loose and where the water table is close to the surface. On the other hand, where the gravel is coarser, requiring heavy driving to effect penetration of the pipe, and particularly where the gravel is loose, with water level at or above the surface of the gravel, the cores are disposed to be excessive. For the purpose of illustrating a method of adjustment, the following two typical drill logs are cited, the one being the log of a hole drilled in an inland area in which the gravel is small to medium and fairly compact, and the other the log of a hole drilled in a river bed in which the gravel is coarse, somewhat loose, and with 3 to 20 ft. of water over the surface of the gravel.

The factor of swell of the core as it enters the pipe is herein introduced. There is no definite basis on which to determine the amount of swell; however, this is not regarded as great, because (1) the driving down of pipe tends to compact the material as it enters the tube, and (2) the material is forced into a pipe of slightly smaller cross-sectional area than that of the cutting shoe. For the purpose of these calculations a factor of 5 per cent has been accepted as representing the average amount of swell in the core. Thus, introducing the swell factor and using the same 200 factor, to arrive at an ideal core:

1 ft. drive : rise :: 1 : [1.54 + (5% of 1.54)]

Which gives for a 1-ft. drive an ideal rise of 1.62 ft.

It will be noted that in the accompanying illustrative drill logs the core-data adjustment has been applied only to that part of the hole in which the values were met.

This method of calculating drill-hole data is not represented as a "cure-all" that will eliminate all discrepancies between tenor as indicated by drilling and recovery by dredging or other method of exploitation. It is merely presented

Table II—Sample Drill Log From River Drilling in Which Core Is Excessive

Water	Depth of Pipe	Depth of Drive	Core Rise	Colors 1	Colors 2	Colors 3	Material
5.1	9.5	4.4	2.2	..	..	2	Gravel, boulders, and sand
	12.0	2.5	2.1	..	..	1	Gravel, boulders, and sand
	14.5	2.5	4.6	..	..	..	Sand, gravel, and boulders
	19.5	5.0	5.9	..	..	..	Sand and gravel
	22.0	2.5	6.4	..	..	..	Sand, gravel, and boulders
	24.5	2.5	3.1	..	..	..	Gravel and boulders
	28.0	3.5	4.2	.	1	4	Sand, gravel, and boulders
	29.0	1.0	2.7	..	..	1	Sand, gravel, and boulders
9.0	34.5	1.6	5.6	..	4	9	Sand, gravel, and boulders
	38.0	3.5	7.1	..	5	12	Gravel, boulders and bedrock

(Penetrated bedrock 1.5 ft.)

Depth water..... 5.0 ft.
Depth gravel..... 27.5 ft.
Depth to bedrock..... 36.5 ft.

$$\text{Constant} = \frac{200}{\text{Depth}} = \frac{200}{28.5} = 7.02$$

Grains gold in hole, 2.158. Grains gold per cubic yard (7.02×2.158), 15.15

Adjustment on core data: (Computing distance from 24.5 ft. to bottom of hole)
Drive, 9.6 ft.
Rise, 19.6 ft.
Desired rise, 1.62×9.6=15.5 ft.
Core factor, 15.5÷19.6=79%

Grains gold per cubic yard: (200÷28.5)×2.158×0.79=11.98

Note: Depth for calculation is taken at 28.5 ft., it being assumed that dredge will dig one foot of bedrock. It will be noted that this hole was started on one day and finished the next, the water level being 3.9 ft. higher on the second day than on the first.

as a plan to elminate the vagaries in calculation resulting from the inability to choose the exactly correct drill-shoe factor for all conditions—that is to say, a factor that is sufficiently flexible to conform to the varying amounts of material sampled, which material is the core which enters the drill tube. Nor can it be accepted as a substitute for judgment on the part of the engineer making the evaluation, which judgment, based on experience, must account for the method of considering erratically high samples and other elements involved in the final appraisal as to the relation between indicated tenor and exploitable recovery. In attempting to arrive at this relation the following axiomatic considerations should be kept in mind: (1) No method of exploitation recovers 100 per cent of the metal in the ground. (2) No plan of prospecting proves the exact metal content of the ground.

Such being the facts, the best one can hope for is to correlate drilling and the resultant calculations with exploitation experience, to the end that a reasonably constant factor will be arrived at that will reflect the relation between tenor indicated by prospecting and recovery by dredging or other method of exploitation. Experience from dredging several hundred acres of ground that can be considered as having been thoroughly prospected by drilling has shown that without the introduction of the core-data adjustments as herein suggested the relation between expectancy and recovery was highly variable—indeed, so much so that the results of various comparisons offered unsatisfactory data on which to predicate future recoveries. On the other hand, it has developed that the introduction of the core-factor adjustment into the calculations, along with other customary considerations as to erratically high holes, character of gravel and bedrock, and related data, has resulted in a parallelism between expectancy and recovery, which forms an excellent basis for establishing a factor to represent the relation between indicated tenor and expected recovery.

Prehistoric Exploitation of Isle Royale Copper Mines

ABOUT 10,000 tons of metallic copper was probably mined from the Lake Superior Isle Royale lode, now in Houghton County, Mich., in pre-Columbian days, according to Fred Dustin, director of an archæological research conducted by the University of Michigan under legislative auspices. Speaking recently before the Michigan Archæological Society, Mr. Dustin said:

"Early explorers of Isle Royale were so handicapped by a dense forest growth surrounding the ancient mine pits that their exaggerations of mining territory extent, number of prehistoric pits, and richness of the ore itself were all somewhat marked. It is not to be wondered at that these early explorers reported an extent of over five miles of prehistoric mining pits, whereas the actual extent was probably not much over one and one-half miles.

"Penetration of the dense growth of virgin forests of those early days—as well as of today—is possible only by following the multiplicity of moose trails. From 700 to 800 moose are living on the Isle. They and their ancestors of the ages have made the only good trails across the Isle—trails which skirt the interior swamps and lakes in ways which would be the despair of the road builder.

"Following these trails over the territory lying between Hay Bay and McArgo's Cove enables the visitor of today to inspect the old mine pits. These average 12 to 20 ft. deep and about as wide, the length varying from 30 ft. to more than 100 ft. The ancient miners apparently selected only the richest veins and attacked them by the well-known fire-heating and water-cracking process. Metal sheets and masses so mined were discarded in the dump refuse if their thickness exceeded ½ to ¾ in., since it could not be formed into weapons by the ancients' pounding process.

"Hundreds of the stone hammers used by the ancient miners are still to be picked up in the pits. Obviously, the miners dropped these simple tools at a moment's notice, but whether such precipitation was the result of storms, attack by foes, or sudden release from slavery, of course no one knows, and conjecture seems idle.

"Transportation routes taken by the copper-laden fleets are commonly assumed to be two in number. Transport to the present Duluth, thence up the St. Louis River, and portage to the Upper Mississippi threw open the whole interior of the continent as a market. The Gulf of Mexico territory and ancient cities farther south may have constituted a large part of the ancients' copper trading market.

"The second route undoubtedly lay via the Soo and Straits of Mackinac into Lake Michigan, and thence south along the eastern shore of present-day Wisconsin and Illinois. This trail is unmistakable, due to modern discoveries of copper fragments and bits of ore stone at intervals along the shore, thus marking the spots where the ancients formed their metal into weapons and ornaments at intervals between coasting voyages.

"That the market for this precious metal extended in prehistoric days from the Lakes to the Gulf—and possibly even farther south—and from the Mississippi to the Atlantic, has been attested by archæologists' modern excavations of the ancients' earthen mounds. Of weapons, tomahawks, axes, spears, knives, and arrow heads have been found in abundance. Very likely copper was more prized for jewelry of that ancient time than is gold today. Ear disks, rings, armlets, bangles, and breast plates were all found in abundance. Perhaps the most valuable antiquity of this kind was a headdress almost perfectly reproducing a full-sized deer's antlers. This headdress was constructed by joining together rolled copper sheets by means of bits of wood or bone."

Discussion following Mr. Dustin's address brought out the fact that the prediction of a federal geologist named Jackson, in 1847, had been justified by the disastrous outcome of several mining ventures of later years.

"Native copper findings are misleading," said Mr. Dustin. "The ore is poorer than it looks, and recovery of $1 worth of copper has frequently cost as much as $10. The ancients solved the problem — perhaps with slave labor. Moderns will probably give up mining on Isle Royale as impracticable in view of modern costs. The Isle is one of the most beautiful spots in the world, totally unspoiled, wild and virginal. A few commercial fisherman of Viking stock living upon the Isle wrest a precarious livelihood from the Great Lakes. The movement is on for the federal government to convert this matchless island into a government park, so that its beauties may be transmitted unspoiled to coming generations."

CARLSBAD N. M.:

Largest, Deepest, Oldest, Newest, Best Lighted of the World's Caves

Edward H. Robie
Associate Editor

CAVES do not receive much attention from mining engineers, unless we except those for which they are responsible; but such caves—caves of rock—are quite a different thing from the kind ot cave to be discussed in this article, which may perhaps more definitively be called a cavern. Although the formation, occurrence, and exploration of caverns are rarely discussed in publications devoted to mining engineering, and probably were not mentioned once by any of the 1,500 who attended the last annual meeting of the A.I.M.E., these natural occurrences are of absorbing interest to almost any one, and should be especially so to mining men. In the realm of underground excavation, Nature has no equal in man, even though he works with the most highly developed rock drills, explosives, and shoveling machines. The huge stopes of the southeastern Missouri lead field remind one of the kitchen in a modern apartment when compared with what one can see at Carlsbad, N. M.

En route from the East to El Paso, my desire to see Carlsbad was stimulated by a talk with the conductor on a Texas & Pacific train. "By no means miss it," he said, and his enthusiastic description led me to alight from his train at 5 o'clock of a winter morning

Photo courtesy National Park Service.

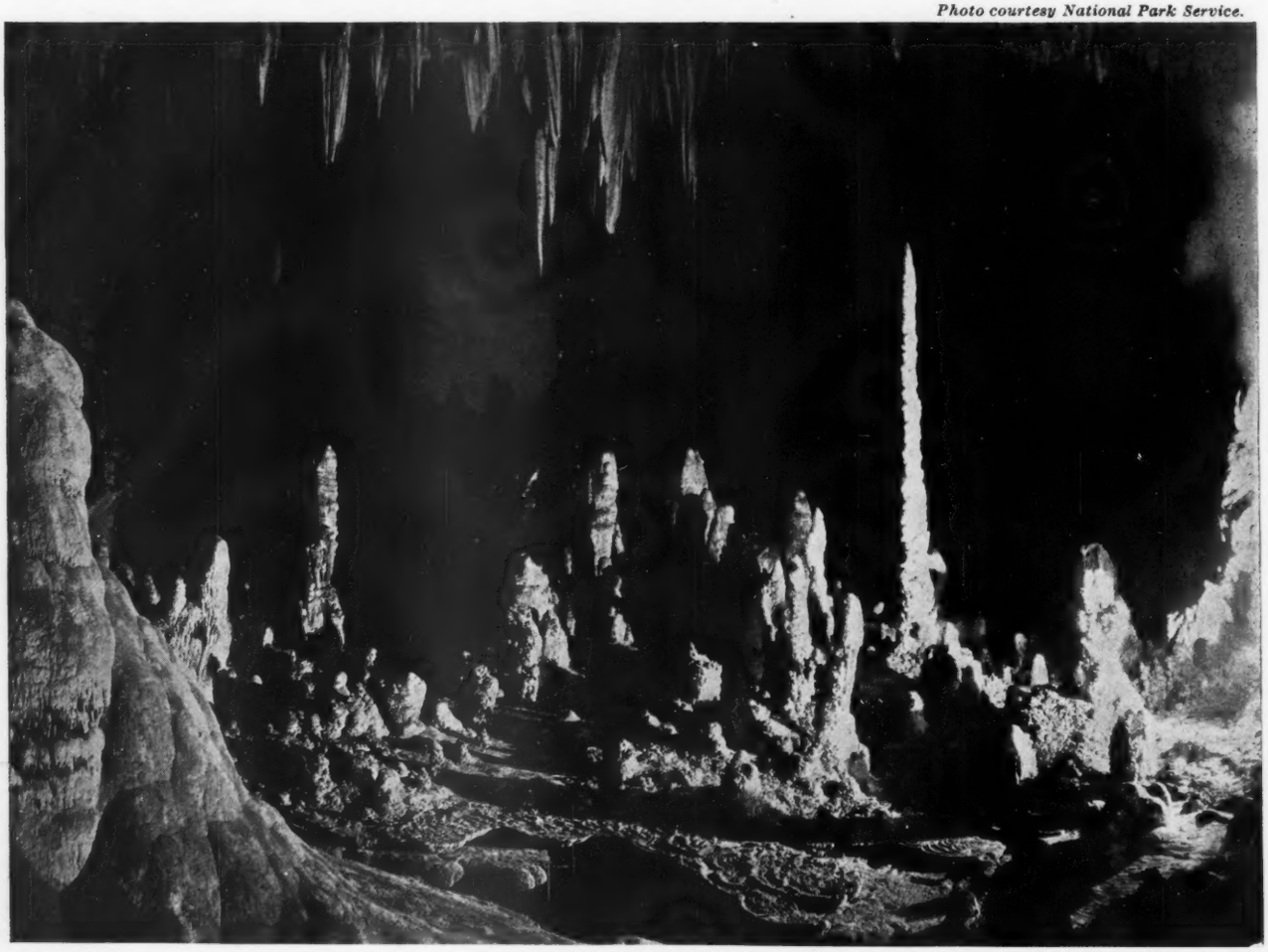


Photo courtesy National Park Service.

at a station known as Van Horn, Tex., where the train always stops — for water. At that time of night the hospitality of the town had limited expression, centering in an owl café and the warm stove in the station agent's private office. The agent was talkative too, telling me more of the wonders of Carlsbad, though this time second-hand, for he had never been there, just as I have never been to the top of the Woolworth Building nor visited the Statue of Liberty.

Van Horn, be it known, is the jumping-off place for Carlsbad, something like a hundred miles to the north, though the cave may also be reached, perhaps more conveniently, by a branch of the Santa Fé. Most people who visit it, however, are motor-car tourists. A regular stage is supposed to run from Van Horn daily. My anticipation of the trip was somewhat dampened by the station agent's revelation that the stage had just been demolished in a head-on collision in a dangerous part of the road; and by the information gleaned at the garage to the effect that the substitute car had come in the day before with a broken spring and was out of commission. These things, as I say, dampened my anticipation, but my determination no whit, though the garage was not particularly enthusiastic about undertaking the round trip for one passenger for the advertised ten-dollar fee. We finally got the broken spring clamped together and, much delayed, got away. Visitors to the cavern are taken through only once a day, at 10:30. If it were 10:30 Mountain Time we could make it if our spring held together; if 10:30 Central Time, we had no chance, and apparently no one in that part of Texas knew which time applied at Carlsbad. Fortunately for me it was Mountain Time.

The Carlsbad cave is one of our National Monuments, operated by the National Park Service, and has been open to the public for only six years. Perhaps a hundred people go through on an ordinary day, though there is often a larger crowd, sometimes making it necessary to show the visitors through in two shifts. Six hours are required for the seven- or eight-mile trip within the cave, with a stop for lunch underground.

The cave does not open into the side of a hill, as one might expect, but extends down from near the top of a mesa. Its entrance is a natural opening of a roughly triangular cross-section, between one and two hundred feet across. The incline at first permits walking down a path, but soon the shaft becomes too steep, so that steps are necessary for much of the trip to the lower areas where horizontal passages and rooms branch off. A separate horizontal extension of the cave near the surface is the home of about 3,000,000 bats, which hibernate there in the winter and use it as a daytime lodging house in the summer months, flying out in a black swarm at dusk. Over 100,000 tons of guano have been removed from this part of the cave, so that in this respect, at least, Carlsbad is a mine, or was, as long as the guano lasted. Presumably more is in process of accumulation; so it may again become a mine.

For the first few hundred feet the descent is not particularly exciting, but from about 700 to 1,000 ft. below the surface, the exhibit of stalactites, stalagmites, helictites, and other forms of crystalline lime formations is awe inspiring. One stalagmite is 16 ft. in diameter and 62 ft. high; its age is estimated at sixty million years. A sheet stalactite, shaped like a giant elephant's ear, and translucent, is 30 ft. long and 10 ft. wide at the top.

Some of the passages have a few large formations; others a myriad of more delicate deposits. In some places huge blocks of the roof have fallen onto the floor; one such block around which the path winds has an estimated weight of a quarter of a million tons. The immense size of some of the openings is striking. The largest is a continuous room 4,000 ft. long—almost a mile—reaching a height in two places of 300 ft., and with an airline width of 1,100 ft. at one place. No adequate description can be given of the impression of grandeur one receives in viewing this sublime handiwork of nature. One of the most effective ways of exhibiting the wonder of the cave is by grouping the visitors near one side of the so-called big room and turning off all the electric lights for a moment; then, a thousand or so feet away a gleam appears, then another and another, lighting up the most striking formations, until the entire vista is illuminated.

One forgets the long walk in the beauty of the surroundings; the only arduous part of the visit is the climb back up to surface, but even that is so much more comfortable than climbing a mine ladder for several levels that one cannot complain, if he is at all used to walking. The temperature is uniform throughout the year at 56 deg. and the air is fresh throughout the cave, circulation being effected by natural means through openings that have so far not been discovered, at least had not until recently.

Were I a geologist, possibly I could make a few intelligent remarks as to the origin of this freak of nature. We were given to understand by the guide that water had gradually eaten its way down through the limestone, gypsum, and salt beds, and hollowed out this cavern, flowing off in some subterranean river. This explanation did not appeal to me, for I could see no way for so much water ever to get into the cave; its mouth is now, and probably has been for ages, pretty well above the level of most of the surrounding country. More likely, it seems to me, is the explanation that the cave was hollowed out by ascending hot water; subsurface evidence indicates this in several places. The stalactites and stalagmites were of course formed in the ordinary way, by slowly dripping water from the roof after the cave was formed, though the interior is now almost entirely dry and only an occasional deposit is still in process of formation.

Exploratory Work

In the headline I have said that this was the oldest and the newest of its kind. Its comparative geologic age is indicated by the size of its formations, which make it antedate any other cavern so far discovered. But its known history is short. The fact that some opening in the earth existed here, as evidenced by the flight of bats in and out, has been known for perhaps fifty years, but there is no evidence that any one actually entered the cave until 1901, when James Larkin White became curious. The deposit of guano was subsequently commercially exploited, and as the underground wonders were discovered and it became evident that here was something grander than anything of its kind, it was taken over by the government. Exploration has continued from year to year, and new sections have been opened to the public. Electric lights, both ordinary incandescent and floodlights, have been installed throughout at points of particular interest. Last year, a total of 21 miles of exploratory work had been done, but much of the cave remained unexplored. A "bottomless pit" or two still existed, and there were a couple of jumping-off places whose fanciful depth could as well be given in miles as in feet.

In the last few weeks considerable more exploratory work has been accomplished, totaling 10 miles, which was duly reported by frequent stories in the New York *Times,* and will be recorded in a book soon to be published. Heretofore, literature on the cave has been practically non-existent, being confined to meagerly descriptive articles in the *National Geographic Magazine* for January, 1924, and September, 1925, and in the *Scientific Monthly* for August, 1925. The latest exploration was organized by Frank Ernest Nicholson, the party consisting of twelve members equipped with radio and telephone apparatus, food sufficient for three weeks within the cave, a captive balloon for exploring the ceiling, photographic apparatus, and other scientific paraphernalia. The so-called lower cavern, not so far open to the public, was explored, this being 1,350 ft. below the surface; some of the bottomless pits were bottomed; another room near the surface, admitting fresh air, was discovered; a dry subterranean river channel was explored; and, according to the *Times,* "for the first time on record we received and transmitted radio messages in the depths of the earth. Our radio station picked up messages and musical programs not only from domestic stations, but from England and Holland as well. We have a complete motion picture and still picture record of our trip." It seems to me that I have heard something about radios operating in mines before, but probably this work has been at least more extensive. Many openings remain to be explored, even though so much has been added to our knowledge by the Nicholson expedition.

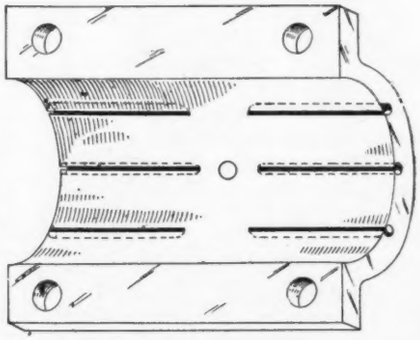
The Carlsbad cavern, as a spectacle, exceeds anything so far discovered. I have not seen the Mammoth cave, in Kentucky, but I have been through the Luray cavern, in Virginia, whose formations, though varied, are on a much smaller scale. The Carlsbad formations, having been on view for only a few years, are much cleaner and fresher looking than those which have suffered from smoky methods of illumination and too much sightseeing. Perhaps the chief competitor of Carlsbad is the Cango cave, near Oudtshoorn, two or three hundred miles from Cape Town, in Africa, though I have not even a second-hand knowledge of what is to be seen there.

Certainly, no one who has a liking for such things, and who finds himself in the vicinity of El Paso with a few hours at his disposal, should miss seeing this unique natural phenomenon, so far so little known. A good motor road is nearing completion by which it may be reached from El Paso in a few hours, or the privileges of a railroad stopover at Carlsbad, on the Santa Fé, or Van Horn, on the Texas & Pacific, may be utilized. Plans have been made for an elevator to carry sightseers from the lower levels to the surface, though my enthusiasm is not great for such conveniences for effete visitors; they will demand jinrikishas or rolling chairs for the seven-mile hike next. Another echo of civilization is going to be protested against in this closing paragraph: the all too common practice of imagining some likeness in every stalactite, stalagmite, or fallen rock. Is it not enough to see these things without calling them "Devil's Den," "Baby Hippo," "Ear of Dionysius," "Fat Woman's Misery," or "Queen's Bath Room?" Must God's creation in onxy be a statue of Andy Gump?

Anchoring Babbitt in Bearings

THE proper anchorage of babbitt in a bearing is important, writes Charles Labbe. Neglect in this respect results in loose babbitt after a comparatively short run. The ordinary remedy is to drill shallow holes radially in the bearing, and this frequently serves the purpose.

A better method of anchorage is to drill the holes lengthwise with the bearing, as close as possible to the inner edge. If the bearing is too large, or if it is not convenient to drill clear through, the holes can be started from both sides, staggered or not, using the ordinary lengths of drills available. The drill will not break if one side of the hole opens on the inside, provided the casting is firmly held and the drill is fed mechanically. Should the holes not open on the inside of the casting, they must be opened with cold chisel or drift, to about half the diameter of the hole. Drilling $\frac{1}{4}$- to $\frac{3}{8}$-in. holes in this manner is rapid and inexpensive.

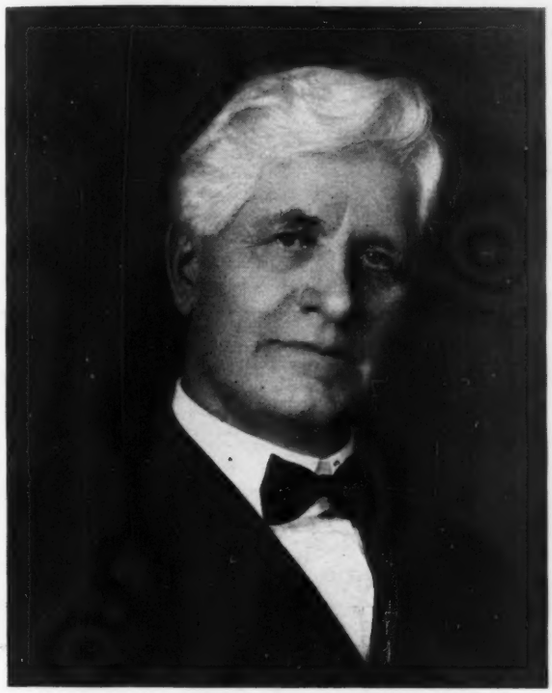


How to keep white-metal bearing lining in place

SAFETY-FIRST PRACTICE and WELFARE AT GREAT FALLS

Edwin Young

Safety and Welfare Engineer,
Anaconda Copper Mining Company,
Great Falls, Mont.



Edwin Young,
safety and welfare engineer

THE question of Safety First and Welfare has been receiving increasing attention in later years at the plant of Anaconda Copper Mining Company, at Great Falls, Mont. In this connection it is interesting to note the important part which the U. S. Bureau of Mines has had in this development. A visit to the plant by the Bureau's rescue car No. 9 in the summer of 1922 aroused so much interest among the men, and the lectures and demonstrations given at that time were so well attended, that the local management, quickly realizing the importance thereof, immediately capitalized the newly awakened interest, and it has maintained a never ceasing vigilance to prevent it from cooling off. Frequent visits by the rescue cars have become a rule, and no effort is being spared to promote safe practices and to instill in the minds of the men the importance of exercising care to protect themselves and their fellow workers. This intensive campaign has borne splendid fruits. The accident rate has been steadily declining, and fatal accidents and accidents causing permanent disability are no longer yearly occurrences. At present approximately one-third of the employees are thoroughly trained and capable of rendering efficient first aid in cases of injuries to their fellow workers. Another gratifying proof of the value of this training is presented in the fact that employees trained at the plant have on several occasions, when off duty, been able to render aid in accidents in the street and on the road under circumstances in which delayed treatment would have meant loss of life.

In 1929 the accident rate was 2.02 lost-time accidents per 10,000 shifts worked, of which 0.61 were classified as serious, involving a loss of time of not less than fourteen days. No fatal accidents occurred during the year. Especially fine records were made during February and March, when the rate was 1.20 and 0.42 respectively, without any serious accident in either month.

The training and instruction of the men are in the hands of the safety engineer and three first-aid men, under whose direction departmental meetings are conducted, attended by men from all branches of the organization, selected to give a good representation and to give every man in the plant the opportunity to attend at some time or other. During these meetings recent accidents are discussed and the causes investigated, and all means are taken to prevent recurrences.

As the records plainly show a lower accident record among the trained employees, the importance of assisting the new man is always emphasized and all are enjoined to assist him until he has become familiar with his work and surroundings and is aware of the hazards. During the meetings the men are also given the opportunity to express themselves upon anything pertaining to safety first and welfare, to call attention to unsafe practices, and to make suggestions about changes and improvements. Records are made of these suggestions and when merited they receive immediate attention in preference to all other work, only the most pressing emergency being allowed to interfere.

All lectures and instruction are accompanied by systematic courses of training, including the classroom instruction of ten hours required to qualify for the U. S. Bureau of Mines first-aid certificate. All employees concerned with detailed plant operation, however, are urged to carry the work on further and to take the regular two-month course of field work and practical in-

EDWIN YOUNG was born in Cornwall 78 years ago and came to this country at an early age. As a true "Cousin Jack" he has been connected with mining all his life, having worked in Michigan, Colorado, Utah, and Montana. His connection with Anaconda dates back to the days of the old Boston & Montana. Mr. Young, who has long ago passed the age when most men plan to retire from active work, has only one ambition—to continue in the work which has become his chief interest in life, and for which he is so eminently qualified. Loved and respected by all, "Ed," as he is affectionately called by the boys, will always be held in grateful remembrance by those with whom he has come in contact during his many years of unselfish service.

Aerial view of the Great Falls plant

struction, conducted every spring. Organizing into five-men teams under the direction of a captain, the men practice treatment of imaginary injuries such as may occur in a plant of this kind. Whenever possible this instruction is given during the regular working hours. In order to stimulate the interest, frequent contests are held, terminating with the interdepartmental contest in June, where all teams are competing for the right to represent the plant in the state tournament and in the international tournament conducted by U. S. Bureau of Mines. Handsome prizes are also offered to the leading teams. Local teams have fared well in competition, taking first prize in two international meets, in addition to tying for second prize once and for third on one other occasion. The management points with justified pride to the many honors and trophies brought back by the teams, but the greatest satisfaction is derived from the knowledge that so many men are prepared to give, and have given, efficient first-aid treatment when occasion demanded, treatment which has evoked favorable comment from the staff of physicians. The true measure of the success of first-aid work lies in the fact that the employees are so deeply interested in the subject that they are voluntarily seeking the instruction which enables them to administer intelligent aid in case of injury.

Four first-aid stations are maintained at the plant, fully equipped to take care of the severest injury, and all employees are urged to have even the most trivial injuries properly cared for, an appeal that has met with excellent response, thus making cases of infection very rare. Complete records are made of all injuries and cases of sickness, and reports are sent to everybody concerned. In addition to the stations, cabinets, equipped with everything necessary to take care of emergencies, are distributed all over the plant in places of easy access. An ambulance is available at all times for use in transporting sick or seriously injured persons from the plant to their homes or to the hospitals. It is also used for transportation of members of employees' families to or from hospitals in case of illness.

No mechanical resuscitation device is kept on the plant, but a modern type inhalator is included in the equipment. This device furnishes low-pressure oxygen to a patient while the lungs are being activated by the manual method of artificial respiration. A staff of three physicians and surgeons is also maintained and the employees have their choice of the services of any of these. Hospital service and medicine are also free, and a trained nurse, specializing in the care of babies, assists in the homes.

Change houses are maintained at various places on the plant, conveniently located for the men, and equipped with modern lockers, wash stands, and shower baths. Hot and cold water, steam heat, and good ventilation are provided, and a janitor is in attendance at all hours. Commissaries are also situated in convenient places, and fresh milk is delivered daily by a dairy that maintains a special truck service exclusively for this purpose.

Club Activities

A spacious clubhouse is maintained on the premises, and it is the center of all social activities. Membership in the ACM club is open to all employees for a nominal fee, and the majority avail themselves of this privilege. The club is excellently furnished, with a reading room and library, billiard and pool

> The growing attention to safety first and welfare work is one of the encouraging signs of the time. No longer is man-power looked upon as a mere commodity, subject to the cruel and relentless laws of supply and demand. Good management is learning to value and strive for the indefinable something summed up in the words "good will," without which no organization can succeed, permanently. In an age in which a growing mechanization is frequently deplored, such signs are the more appreciated. He who has eyes to see is realizing that in the industrial era of tomorrow, man will be less a slave of industry than industry will be the servant of man.

tables, and has a gymnasium, bowling alleys, horseshoe courts, two practice golf courses, in addition to an outside six-hole golf course and three tennis courts. Realizing the importance of promoting a competitive spirit, frequent tournaments are held and great interest is aroused among the men. Bowling commands the greatest following, and during the winter season several hundred men participate in the tournaments. The six alleys, which rank as the best in the state, have been the scene of several state tournaments, in which teams from the club have taken many honors. Last year a baseball league was started, with over a hundred men participating, and so great interest was shown in this activity that many new teams are expected to be added this year.

Frequent smokers and get-together meetings are held during the winter months, featuring musical entertainment, vaudeville acts, and shows. A monthly paper, the "ACM Club News," is devoted to these activities and has gained great popularity among the employees.

The Engineering Club, open to all men in the organization, meets every two weeks during the winter season. All running expenses are defrayed by the company, and no dues or assessments from the members are required. The meetings, which take the form of smokers, are held at the club rooms. This organization aims to give the men a better understanding of the company's operation and to make them familiar with outstanding engineering achievements. Lectures, generally accompanied by slides or moving pictures, are given by members of the staff or by invited lecturers whenever such are available. These meetings are always very well attended, and the men are highly appreciative of this opportunity to acquire knowledge.

Once a month a luncheon is given at the clubhouse for all department heads and foremen, where costs, accident rates, general welfare, and matters pertaining to management are discussed. Thus these men are given the opportunity to become familiar with the operation of all departments of the plant, affording them a broader view of the company's activities. This meeting also includes a talk given on some subject of general interest, not necessarily of technical nature, as a rule by an invited speaker. The management has made it a rule to invite a representative group of professional men to these meetings, to give them the opportunity to become acquainted with the activities of the company and to allow them to meet the men in charge. This has proved a successful arrangement, and it takes away much of the impersonal feeling with which an outsider generally views a large organization, and aids in eliminating the friction and distrust so often evident in mining camps.

ACM Club

Great efforts have been spent during the last ten years to beautify the grounds and make the plant look clean and attractive. Lovely lawns have been laid out wherever the space is available; thousands of trees have been planted along roads and walks; and rose bushes, flowers, and shrubbery abound. Flagpoles and sparkling fountains add to the attractiveness of the picture. The luxurious growth disproves any statements about unhealthy fumes and proves the folly of the old conception of an industrial plant as a place of filth and dirt. Money expended for work of this nature may not give returns directly traceable on the profit statement, but the effect upon the morale of the men cannot be overestimated. Good working conditions and attractive surroundings have their part in the remarkable drop in the labor turnover of late years. Order and cleanliness are also enforced in the interior of the buildings, and anybody familiar with metallurgical operations knows that a clean plant is less expensive to operate, has lower metal losses, and is a safer place in which to work than one in which opposite conditions prevail. Another important factor is that this work provides dignified and wholesome occupation for a large number of deserving employees who have reached an age where a more strenuous occupation is no longer desirable.

Shop men at lunch

With the pride of him whose house is in order, the management has always maintained a liberal policy toward all visitors. Guides are provided during the summer season to handle the large number of visitors that daily wish to inspect the plant, some of whom come from the remote parts of the earth. And to such no better example could be furnished of American industry and American enterprise.

Advice to Those

Frederick MacCoy

Seeking Employment in Latin America

MANY engineering students are considering seeking employment in Spanish America; and as I have spent much of the last twenty years in South America and Mexico, the opinions that I have formed may be of use to those students, or to others of more experience who may be considering a similar move.

One goes to a foreign country to better one's financial condition, to find a different climate, for adventure, for family reasons, for experience in one's chosen line, and for other reasons. For the engineering graduate almost any of these may be involved, probably the reason, acknowledged or not, that has inspired the greater number of engineers to go to any foreign country has been adventure, or romance, as some may call it. Who of us, on reading Richard Harding Davis' "Soldiers of Fortune," has not imagined himself as the hero of some such a story, of the American engineer, in some semi-tropical Spanish-American country, bossing a bunch of "natives," building a great bridge, opening up a rich mine, defeating the villain in spite of his fierce mustache and dagger, and so on. It has happened before; why not again?

To those so inspired I will say, truly it has happened before, and may happen again—*quien sabe?* On the other hand I know of various neglected graves in those countries that bear all that remains of some of those engineers who came out on the other end of the game—some of whom I was proud to call my friends. The successful engineer is not usually the one that seeks adventure, but he may get his fill of it where least expected.

In general, engineering positions of equal importance pay better salaries in Spanish America than they do in the United States, but many considerations must be taken into account to ascertain if one comes out better in the end. Living conditions are different. The man who can adjust himself to different modes of life will fare better than the one who always must have what he has been used to.

Members of colonies of Americans in foreign countries usually live a little faster, show less concern for expense, and part with their money for less return than those at home. I do not mean to say that the engineer living in Spanish America will be in any more danger of lowering his moral standard, because this is a personal characteristic and can develop just as easily at home as abroad. Striking an average of my acquaintances among engineers at home and those that have spent ten years in Spanish America, I would say that there is little to choose as to their comparative financial situation.

On the whole, it is easier for an engineer to get a job in Spanish America; but—mark the difference—it is harder to hold it. Too many men go to Mexico thinking that they will have a snap, that any kind of work will get by, that any kind of engineering will be better than what they have to compete with, only to find that they do not have the support of a good shift boss, or an old-timer on erection to save the day when figures play one false. The native foreman expects the engineer to be capable. So long as he finds him so he will follow his orders blindly; but when the plans don't work out, he merely shrugs his shoulders and walks off. More executive qualifications are required in handling men of lower mental standing than in handling a group that more nearly approximates the intelligence of the chief. The boss who is introducing new methods must be sure that he not only knows the work himself, but that he is able to instruct the men in the work. This naturally means that he must speak their language.

Men who never learn Spanish are not successful in handling the Spanish-American workmen. In many countries the laws demand that all orders for work be given in the language of the country, whether spoken or written; but the engineer finds that seldom does the Spanish that he learned at the university help him much in talking to the workmen. Not that he talks more correctly than the workman—usually he does not—but he has learned a vocabulary that does not fit the situation.

I suggest to the engineering student going to Spanish America that he study the usual Spanish course, that he get the different conjugations letter-perfect, and that as soon as he is located in his new place he hire a teacher in conversation. Don't expect the new acquaintances that you make among the new people to help you a great deal. They will not correct you, but will allow you to blunder along, and keep a straight face over your most ludicrous mistakes, because it is a point of their etiquette not to laugh at another's bad grammar.

Among those persons that should not go to live in Spanish America are those with subnormal digestive organs, those that cannot stand being lonesome, those who must have their bath on arising, the married man whose wife has social aspirations, and the one that imagines that nothing worth while can exist outside of the old U. S. A.

The spicy food of Spanish America is not a food for a dyspeptic. For that matter, the average American who goes in heavily for chile and fried food has his alimentary tract well plowed up and ready for the numerous unfriendly bacteria that lurk in semi-tropical countries. It is hard for anyone to be lonesome, and this can just as easily take place in a large city as in the mountains; but the city where the passer-by speaks a language that one hardly understands is the climax.

In the United States, the passing generation, the one that brought in the general installation of bathtubs in the home, have made us more dependent upon our daily bath than our grandfathers were. Spanish America is just learning the habit, and the facilities are rarely available. Those with social aspirations, and those over-critical of conditions outside the United States, will not be contented in Spanish America.

Especially is the married man worthy of special treatment. If his wife is able to adjust herself to different living conditions, and if they have no children, they may find a happy life in a foreign land. Some women with children think Spanish America a paradise, because servants are plentiful and the mother, therefore, has much more freedom. She can get around much easier. However, the disadvantages must be given due consideration. Doctors are not so numerous nor so competent as in the United States. A mining and construction camp usually has a surgeon, but with little experience with children's sickness. Milk—the child's food—is not dependable as to quantity or cleanliness. Schools are rather haphazard, and English schools scarce. The relative degrees of morality of the servant class are a constant example to the child, and by no means a good one.

To the student who, in spite of the foregoing, still has a desire to go, I would suggest that he try to secure employment with a company that has been operating in the country for some time, and therefore has an established staff and customs. If you go on contract, look well into its terms. Don't make it too long. I think that a two-year contract is fair to both parties. That will give you time to repay the company for lost time in instructing you, for you will be worth little for six months, six months more will find you an asset, and the final year ought to show whether you have made a place for yourself or have merely held your job.

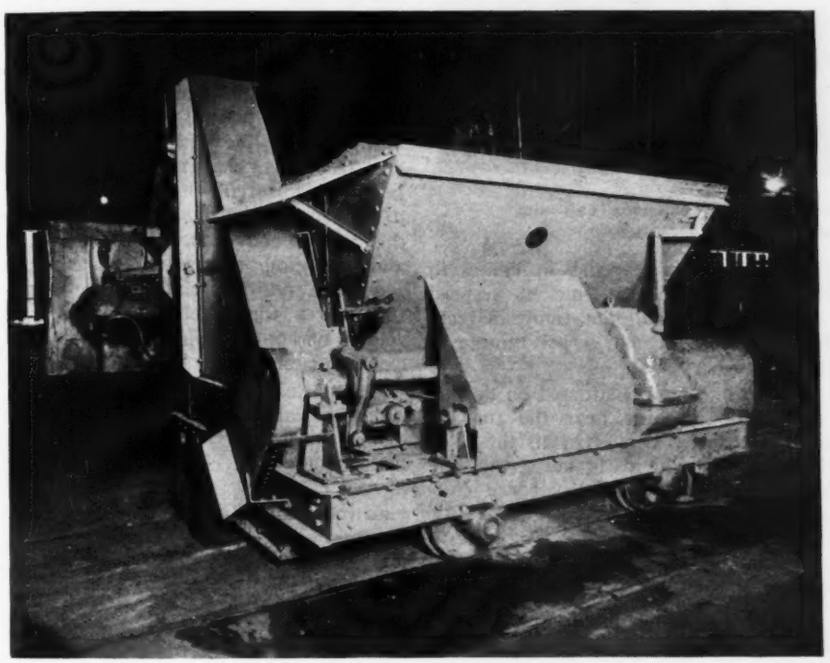
Retort-Charging Machine

G. L. Spencer, Jr.,

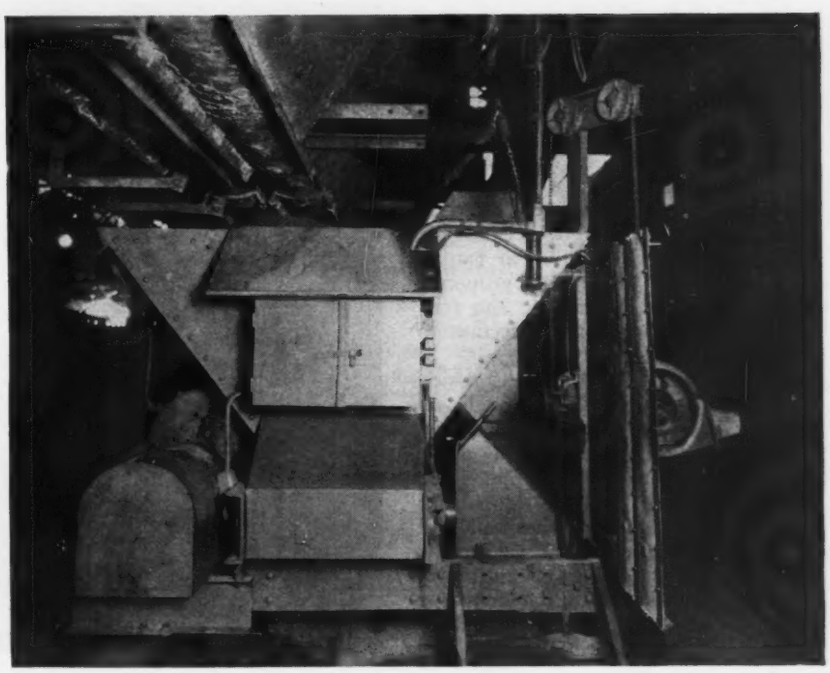
Assistant Chief Metallurgist,
American Zinc, Lead & Smelting Company,
East St. Louis, Ill.

RETORT charging machines may be divided into two classes, according to the method of operation, which depends upon whether parts of the machine extend into the retorts during charging or the machine operates only externally and throws the charge into the retorts. Both types have advantages, but owing to the fact that, other factors being the same, a machine of the external type can be designed to operate faster than one of the other type, the machines at the East St. Louis plant of the American Zinc Company of Illinois were built according to an external type of design. In general, the machine consists of an electrically driven car, operating on a track parallel to the furnace, with a hopper storage bin of such capacity as to hold sufficient charge for one row of retorts. Equipment on the machine removes the charge from this bin and drops it in the path of a cup or paddle, which, while revolving at a high speed, throws the material through a peripheral spout into the retort. All controls are placed on the operator's platform, which is at one end near the furnace side of the machine, so as to enable the operator to observe continuously the charging of each retort.

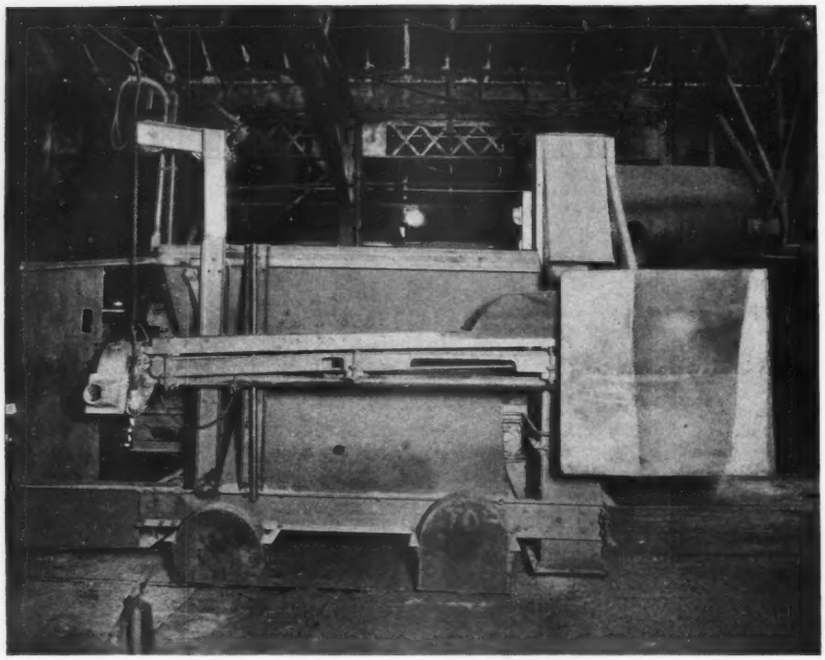
The charge bin, pyramidal in shape, has a capacity of 200 cu.ft. and is open at the top, so that it can be filled from overhead storage bins. An apron conveyor, 30 in. wide, which forms the bottom of this hopper, serves to remove the charge and drop it into a bucket elevator at the far end of the machine. This elevator follows a triangular course, the bottom of which is of the same width as the apron conveyor. This arrangement prevents any side motion of the charge material while it is being



The transmission, apron conveyor, and bucket elevator drives are seen in this general view of the machine



Front-end view of the machine, showing operator's platform and controls, driving motor housing and transmission



Furnace side of retort-charging machine, showing charging unit and elevator discharge

discharged from the apron conveyor. The bucket elevator takes the charge to the top of the furnace side of the machine, where it is dropped onto a 6-in. conveyor belt that brings it back along the side of the machine to the charging head, in which the revolving charge cup is housed. The peripheral spout, through which the charge is thrown, extends to within 18 in. of the retort mouth. The charge is thrown a maximum distance of 7 ft.

Two 15-hp. motors which operate at 1,800 r.p.m., receiving power from an overhead trolley, supply power for the machine. One motor drives through the transmission, which is fully inclosed and equipped with cut-steel gears running in oil. A pinion shaft, running at 350 r.p.m. out of the transmission, is connected, through a double bevel friction clutch having a ratio of 3.7 to 1, to a shaft parallel to the car axles and connected to both of them with chain drives. The gearing is such that the maximum car speed in either direction is 200 ft. per minute. With this arrangement, the car can be moved in either direction by merely moving the lever controlling the friction clutch in the proper direction to accomplish the result desired.

Another shaft from the transmission drives the apron feeder through an eccentric pawl-and-ratchet device, and the bucket elevator through a chain. This shaft is controlled by a jaw clutch included in the transmission. The apron feeder has a 4-in. head-and-tail shaft, which operates at 2 r.p.m., the driving sprockets being of such size that the linear speed of the conveyor is 8 ft. per minute. The elevator chain is 21 ft. long and is equipped with 28 10x5-in. buckets, spaced 9 in. center to center. This elevator runs at a speed of 180 ft. per minute and easily delivers 10 to 12 cu.ft. of charge per minute to the conveyor belt.

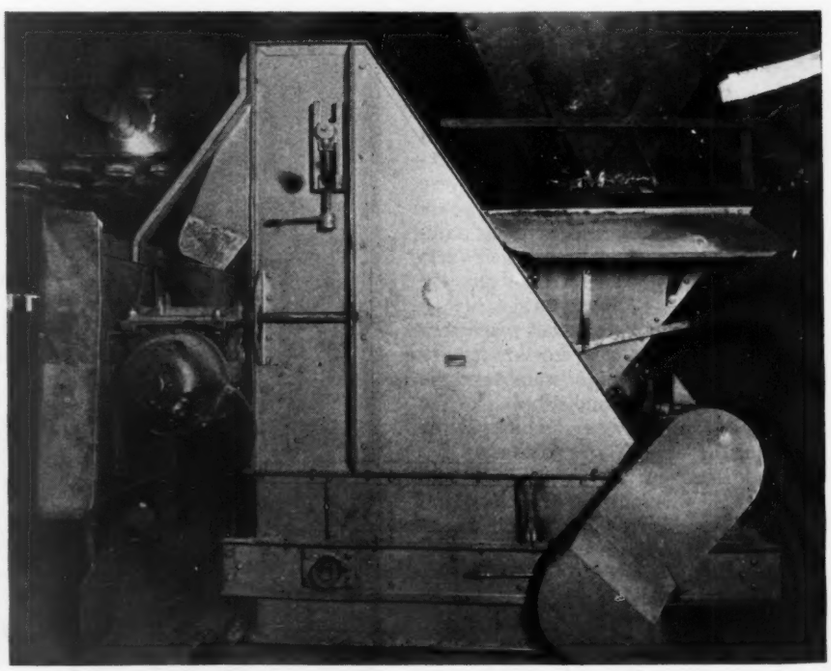
The second motor, situated on the far end of the machine near the furnace side, is directly connected to the long shaft upon which is fastened the charging cup; it also drives the conveyor belt through a set of gears. The charging cup has a tangential velocity of 6,000 ft. per minute, and the conveyor belt a linear speed of 650 ft. per minute. This unit is fastened to the car frame by a pivot arm working in a vertical slide, so that the entire unit may be elevated at either end by a hand-operated chain hoist. The manganese-steel charging cup has to be replaced after 650 to 700 retorts have been charged, and the steel liners in the charging head are replaced after from, say, 450 to 500 retorts have been charged.

As most of the wear on the liners occurs over a short segment, they can be reversed, thus giving the aforesaid life. Both these parts are accessible, and the time required to change either is negligible.

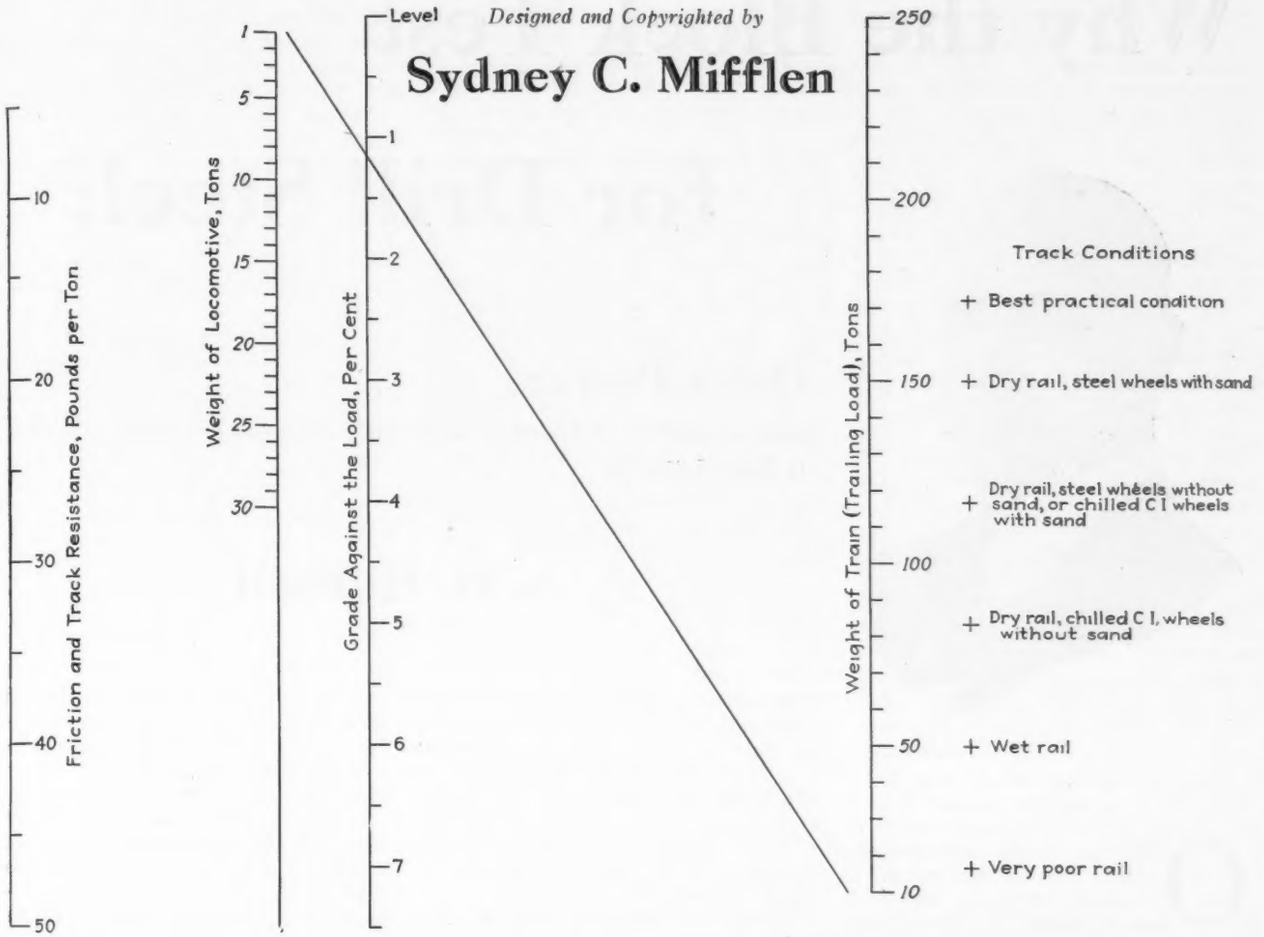
Owing to the design of the furnaces at this plant, the retorts are charged by rows. The average time required to charge each row of 80 retorts is 20 min., or 15 sec. per retort. Usual practice is to move the machine so that the charging head spout, which is set at the same angle as the retort inclination, is directly in line with the first tier of retorts. The charging unit is then raised or lowered with the chain hoist to the row to be charged, after which the apron conveyor, bucket elevator, and charging units are started. As soon as a retort is charged, the operator moves the machine to the next retort without stopping the flow of charge material.

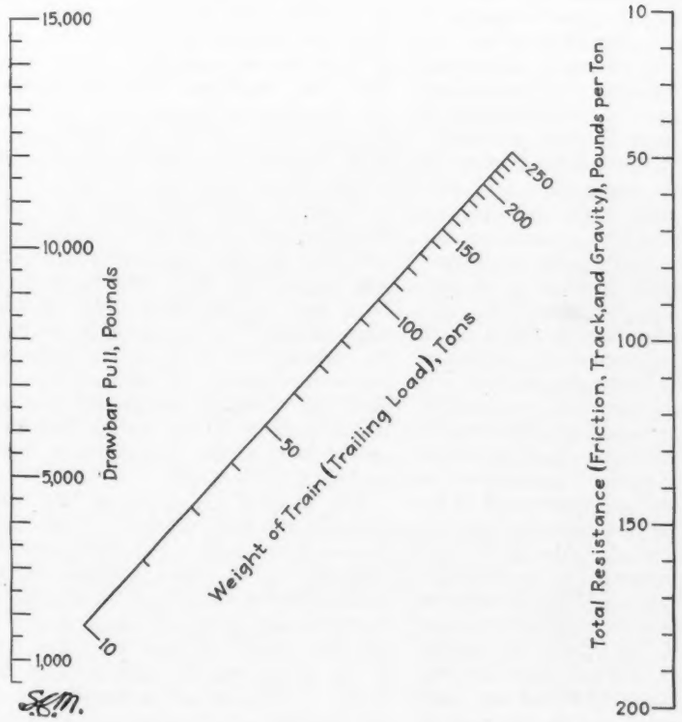
Owing to the fact that the charging machine can move rapidly and the distance between retorts is small, an undue amount of charge is not thrown on the castings. A man following the machine rakes the charge off the castings and spiesses the retort, after which the condensers are set up and loamed.

The method of loading the charge bin is shown in this rear-end view



LOCOMOTIVE WEIGHT CHART





THE upper part of this chart may be used to find the trailing load any given locomotive will handle under known conditions of track, grade, and train resistance, whereas the lower part of the chart will show the drawbar pull necessary to maintain motion. The several converse problems, such as the grade over which a locomotive will haul a given load, may also be solved from these charts.

EXAMPLE: What weight of steel-tired locomotive will haul a 60-ton train over a 2 per cent grade, assuming a dry rail, without sand, and a train resistance of 30 lb. per ton?

PROCEDURE: Align 2 per cent on the *Grade* scale with 30 lb. on the *Resistance* scale, and hold the point of intersection on the *Locomotive* scale. Align 2 per cent on the *Grade* scale with the point indicating *Track Condition* to intersect the *Weight of Train* scale at a point, which point join to that similarly found on the *Locomotive* scale, intersecting the diagonal scale at a point. Align this last point with 60 tons on the *Weight of Train* scale to intersect the *Locomotive* scale at a point reading 9.1 tons. A 10-ton locomotive would probably be chosen.

Under the above conditions the total resistance $= 30 + (0.02 \times 2{,}000) = 70$ lb. per ton. Aligning 70 lb. on the *Resistance* scale of the chart to the left with 60 tons on the *Weight of Train* scale, the *Drawbar pull* scale is intersected at a point reading 4,200 lb.

Why the Block Test for Drill Steel?

Ocha Potter,

Superintendent of Calumet & Hecla's Ahmeek-Kearsage Division, Is Interviewed by

A. H. Hubbell

Associate Editor

ONE may safely say that the quality of drill steel offered to mining companies today is much better on the average than that sold six or seven years ago. The chief cause of this improvement is undoubtedly the widespread adoption by operators of the practice of "block-testing" the steel to determine its ability to withstand breakage in the bar. This test, as most operators know, consists, briefly, in placing a piece of steel of specified length and diameter in a rock drill with the bit about ¼ in. from a steel anvil block and running the drill under certain standard conditions until the steel fails in some way from continued pounding against the block.

Some argue that the block test, being a shop test, is not a proper indication of the life of steel in underground use. They contend, also, that a steel that will stand the block test best will probably not make bits that will stand abrasion best. These points are blunted by facts, however, as the following account of the origin, development, and procedure of the test method will show.

Ocha Potter, superintendent of Calumet & Hecla's Ahmeek-Kearsarge division, in the Michigan copper country, is perhaps the individual best qualified to talk on the subject of block-testing. The method was developed by his company under his direction and has resulted in an appreciable saving in money spent for steel. So many requests for further information regarding the work done at Ahmeek have been received by him that last year he found it desirable to prepare a circular letter of information which he now sends to all inquirers. By way of giving this wider circulation, its substance is incorporated in the following account of a long interview granted by him to the writer some time ago.

About 1922-23, according to Mr. Potter, Calumet & Hecla persuaded the Chicago Pneumatic Tool Company to develop a faster hitting machine, the CP-5. This the company adopted as standard at Ahmeek, but soon found that its high speed broke drill steel so fast that the cost of steel per ton of ore was more than doubled. Inasmuch as the ore was fairly hard and costs were already quite high, this breakage became an important factor, so that some way was sought of cutting the cost, in order to make it practical to continue using such a high-speed machine. The company's problem was to find a quick, inexpensive, and dependable method of determining the particular kind of drill steel that would meet this requirement. Correspondence was had with leading drill-steel manufacturers and prominent technologists of various universities, as well as with various departments of the federal and state governments, but none could suggest relief. About the only data available appeared to be some obtained in high-speed vibration tests to determine fatigue, such as had been used in testing steel for automobile service. These, however, did not meet the conditions under which drill steel was being used, and so could not be regarded as having application to the company's particular problems.

At this time, someone recalled that about 1912-13 one of the operatives at the Champion mine of the Copper Range Company had conceived the idea of "block-testing" drill steel. Mr. Potter says that he thinks that a Mr. Paulson, now with the Crucible Steel Company, originated the idea, but it had not been extensively used and the technique of testing had been only partly developed, owing to the fact that with the old slow-speed drills then in use the cost of drill steel per ton of ore was so small as to be almost negligible. Some years later Mr. Wohlrab, superintendent of the Isle Royale Copper Company, had developed the use of the block test a little further, but had also practically abandoned the method.

Available data were secured by the Ahmeek company from the Champion and Isle Royale, and experimentation was begun with drill steel on a fairly large scale in the fall of 1923. Results were sufficiently encouraging to warrant the employment of technical engineers for further study. Within six months they had obtained enough information to feel justified in buying all drill steel on the basis of the record that it made on being block-tested.

The method of mounting the rock drill and the anvil block for conducting the test are shown in the accompanying drawing. This shows a CP-5 drifter mounted on an iron base consisting of two 15-in. channels and having a standard 5-ft. length of steel with one end in the chuck and the other against the block. Following are a few details of the company's 1929 practice in conducting these tests:

1. An average of the results of break-

ing down (to failure) ten steels from a carload lot is accepted as final.

2. Air pressure varies from 79 to 81 lb.

3. Two CP-6 machines are now used for these tests. They are run simultaneously on the same set-up. They are used only for this service and are idle when not being used in this manner.

4. A continuous flow of water through the drill steel is maintained to keep the steel fairly cool. Its temperature is about 40 deg. F.

5. The drill is cranked forward as far as it will go with the steel in place and then reversed one-half turn or about $\frac{1}{4}$ to $\frac{5}{16}$ in.

6. This clearance is checked every fifteen minutes during the test.

7. For lubrication, No. 1 castor oil is used in the machines. A Denver line oiler is used and, in addition, oil is put in the machine every thirty minutes.

8. The first square break is accepted as final even though it be only $\frac{1}{2}$ in. from the end of the steel.

9. Drill steels are cut 5 ft. long and squared at both ends, but are not heat-treated.

10. The anvil block is 2 by 3 in. and made of Spec. A steel bought from the Crucible Steel Company. This block is machined to fit closely, but is not heat-treated in any way.

11. The hole in the block is $1\frac{1}{4}$ in. in diameter (for 1-in. hexagon steel) and $\frac{3}{4}$ in. deep. When worn to $\frac{7}{8}$ in. depth, the block is discarded. It is often discarded because the hole in the steel causes a horn to rise from the bottom of the block. This horn plugs the drill and blocks the water. Uneven surface at the bottom of the hole is undesirable, as it causes variation in breakage.

12. Drill steel used as standard for these tests is 1-in. hexagon.

Since the successful outcome of the early experimental work, all drill steel has been purchased by Calumet & Hecla on the block-test basis. Every carload of steel that comes in is tested, even though presumably the manufacturer is still using the same method in its production. The result has been a saving of approximately 50 per cent in the cost of drill steel to the companies under its management.

During the past five years Calumet & Hecla has co-operated with 22 companies in setting up and operating block-testing equipment. Most of these were mining companies, some were manufacturers of drill steel, three of them are in Sweden, one company was in England, one in Mexico, two companies were in Canada and the rest were in the United States.

The company's experience in testing many thousands of steels (it has tested every kind manufactured) has indicated that each testing plant must develop its own technique and determine its own practice. That is to say, it is impracticable to set up a testing plant that will give results which can be directly compared with those obtained by any other plant. In the many cases in which the company has co-operated in setting up plants elsewhere, never has it been brought to its attention that results are directly comparable. Every plant must determine its own standard. A slight variation in any one of the many details of the test may cause such a variation in results as to invalidate them. For instance, a variation in foundation beds, in weight of equipment, in air pressure, in the rock drills themselves, in the operator's judgment, in attention given to oiling the machines, in the amount and temperature of water flowing through the drill steel, in the quality and size of the test blocks, in the depth to which the hole in the test block is permitted to wear, in the use of one or two machines on the same set-up—all or any one of these variations will cause a variable result even though the drill steel tested is absolutely uniform.

Each test plant must therefore determine for itself its technique and standardize its methods. Great care should be taken to avoid variation in any one of the details mentioned in the foregoing, so that the final result may be regarded as indicative of a variation only in the drill steel tested.

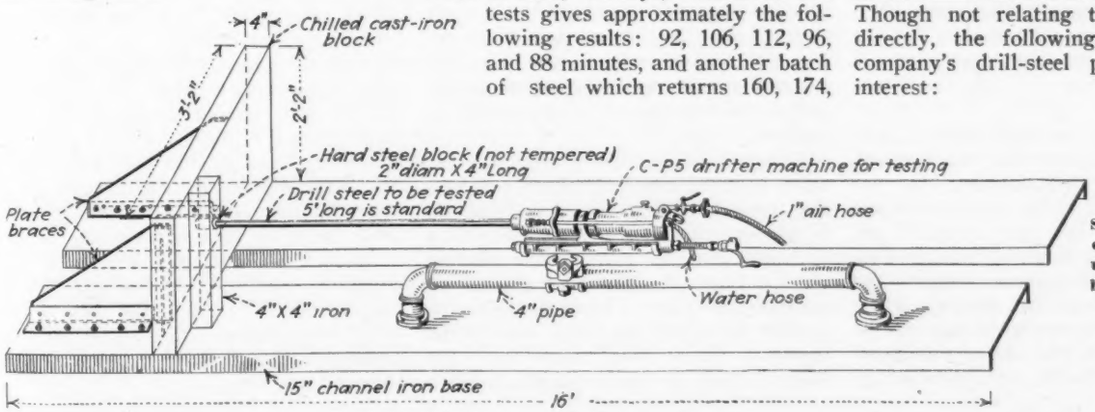
In the information that he has prepared for other operators Mr. Potter says that when they have run tests enough to feel reasonably sure that they need make no further changes in equipment or practice, they are ready to study the results of the test. "If you find a batch of steel," he says, "which for five tests gives approximately the following results: 92, 106, 112, 96, and 88 minutes, and another batch of steel which returns 160, 174, 148, 190, and 121 minutes, you can rest assured that the second batch will give approximately that much better service so far as drill-steel breakage is concerned. We find variations much greater than those indicated above. We have tested sixteen makes of drill steel with average results as low as twelve minutes and as high as 140 minutes, using the same methods of testing. Results in actual service have followed very closely the result on the block test—and at this branch alone we use over 900,000 steels annually and break about 60,000 each year. You may therefore appreciate that our opinions are not based on theory alone."

Buying in carload lots entirely, and testing on a fairly large scale, Mr. Potter says his company finds a great difference in results between its tests and the manufacturer's. But the ratio, he says, between its results and those of the manufacturer is quite uniform.

Mine operators will be interested to hear Mr. Potter's opinion, if indeed they have not already come to share it themselves—namely, that old steel is worth little. One interesting test showed that steel that had already broken down to four feet in length would break within two or three minutes or at once on being block-tested, this indicating that when steel has reached this point, it is ready for scrapping.

It is, of course, not unlikely that had no block-test methods been developed, radical improvements would nevertheless have been made in the manufacture of drill steel. However, the insistence of Calumet & Hecla on the use of the block test has undoubtedly hastened this improvement and been a source of encouragement and assistance to those manufacturers who have conceded its value.

All that block testing does, says Mr. Potter, is to determine the ability of steel to withstand breakage in the bar. It has no bearing on the wear of the cutting edge of the bit. His company assumes that no drill steel will be offered to it that will not take a temper or heat-treatment. If a drill steel indicates satisfactory results on block testing, the company's next test is to form bits, temper them properly, and test them to determine the life of the cutting edge. Though not relating to block testing directly, the following notes on the company's drill-steel practice are of interest:



Sketch of equipment used in block-testing drill steel

Tempering is effected in Lake Superior water at practically constant temperature. Magnet control is used for determining temperature only on the bit. Steel used in the company's mines is a straight carbon variety. The company has certain requirements for drill steel. It must take a proper cutting edge in the bit and must resist breakage in the bar, to which 90 per cent of loss has been due. The chemical constituents of a particular piece of steel, the temperature at which it has been treated in the manufacturer's plant, the way in which it has been rolled or drawn, are problems of the drill-steel manufacturer rather than of the consumer.

Steel used underground is 1-in., hollow hexagon, which is standard for all machines. No jackhammers are used, save by surveyors. The standard drill used at the Ahmeek today is the CP-6. This is a one-man machine, there being no two-men machines in the district. The mounting used as standard is the post and arm (elsewhere known as column and bar). This mounting is used horizontally in shaft work. The method of stoping employed varies considerably.

As for the life of steel, says Mr. Potter, it may last six months in hard ground, or up to 1½ years elsewhere. It finally reaches the junk pile. Usage in the Ahmeek calls for five pieces of steel to a set, with a 22-in. round or change. There are long and short sets, one shaft using the long and another the short. The lengths of the steels in the short sets are 30 in., 52 in., 74 in., 96 in., and 118 in. In the long sets, the lengths are 36 in., 58 in., 80 in., 102 in., and 124 in. This practice tends to reduce wastage of steel, as any mine foreman will readily understand.

About a year ago Calumet & Hecla made a very interesting laboratory test underground to determine the effect of increasing the air pressure on rock drills from 80 to 150 lb. The test was made on six machines. The steel as well as the machines were punished badly. Thereupon, the company looked into alloy steels and obtained sixteen batches and with them made a five months' test. The net result was that the company came to the conclusion that no machine on the market at that time would stand up under 150 lb. Drilling speed or the footage drilled using pressures ranging from 80 to 150 lb. was found to be almost directly proportional to the air pressure. At 150 lb. it was really doubled.

In estimating "footage drilled," only the reciprocating time of the machine was taken into consideration. This was only 25 per cent of the total time of the miner's shift. The remaining 75 per per cent of his time is consumed in setting up, barring loose ground, and in mucking and similar operations, and by speeding these up the footage can be increased. Up to the time of this interview with Mr. Potter, excessive breakage at 150-lb. pressure had been found to more than offset the gain due to increased drill efficiency obtained at the higher pressure. As for lubrication, it was found that the higher pressure would have no effect on this up to 150 lb., but at 200 lb. the drill became so hot that the lubricant and the air mixture exploded on exhaust. Likewise, above 150-lb. pressure, the lubricant was blown out of the machine.

In the first part of this article, reference was made to high-speed vibration tests for fatigue, which had been made elsewhere. This reference to fatigue caused Mr. Potter to say that few talk nowadays of fatigue of drill steel. Breakage in drill steel is supposed to originate in flaws in the steel which are increased by pounding until the steel breaks. Curiously enough, the steel made by one company will invariably break from the inside out, and that from another will break from the outside corner toward the center, this indicating that the difference is due to the method of manufacture. Some use the word fatigue indiscriminately, says Mr. Potter. Its proper use depends on what is meant. Many engineers were consulted and the general opinion of those best qualified to answer seemed to be that the term "fatigue" should be applied only where blows on the metal were so rapid as to cause a readjustment of the grain of the steel. In testing for what is technically known as "fatigue," a certain testing laboratory was using 120,000 blows per minute, whereas in actual drilling practice no machine of which Mr. Potter knows hits over 2,300 blows per minute at ordinary mine air pressure, and all the experts with whom correspondence had been conducted agreed that there is no readjustment of grain structure at such low hitting speeds. The proper conclusion therefore seems to be that the term "fatigue" has no application to ordinary mine breakage. If certain steel manufacturers have changed the structure, it has been to get uniformity, and not to fight fatigue. One manufacturer is known to have improved his steel simply by speeding up his operations of rolling and complementary details of manufacture, thereby reducing the range between the initial and the finishing temperature.

Testing Sheet Steel for Weldability

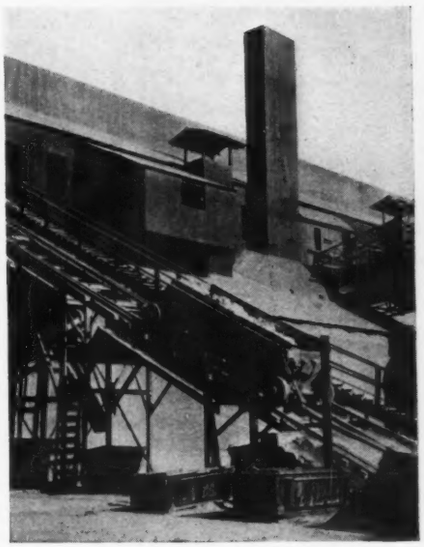
CAREFUL selection of good material is a prerequisite to successful oxy-acetylene welding of steel sheet. Inferior sheet is bound to produce an unsatisfactory result. Chemical composition alone is not sufficient indication of quality. Welding qualities are determined to a great extent by the presence or absence of minute amounts of impurities in the steel. This holds especially true for thin sheet steel. These impurities are sometimes so small that only a good microscope can detect them. They do not show up in the chemical analysis, but have a very decided effect on the behavior of the steel under the welding flame. It is always advisable, therefore, to specify that the steel shall be suitable for welding and as a further check to test lots of steel as they are received from the mill. Such a test is easily made as follows:

Select a piece of sheet from the lot, about 6 in. square, and place it flat on the welding table. Fit a welding tip to the blowpipe on the size smaller than that prescribed for work on the welding chart. Light the blowpipe and adjust the flame to neutral. Hold the blowpipe so that the tip of the inner cone of the flame is about ⅛ in. away from the sheet. Move the flame slowly along a straight line so that the sheet will be melted without burning clear through. After a strip about 3 in. long has been melted in this way, hold the blowpipe still until a hole is burned through the sheet.

If the sheet is of high grade, the path followed by the blowpipe will be free from an excess of oxide or scale and regular and smooth on the upper side. The under side will show a slight sag of smooth metal, free from oxide. The hole will be round and have smooth, rounded edges.

Sheet of inferior quality will show an oxide deposit on the upper side, part of which will be porous or flaky scale. There will also be a succession of irregular ripples, higher in the center than on the edges. The under side will show a sag that is covered with oxide. There may even be a series of small holes blown through by the sparking action of the impurities. In poor sheet the metal will be burned through soon after the blowpipe is held stationary, in much less time than is necessary to put a hole in good sheet. The hole, incidentally, will be irregular with rather ragged edges. When the test sheet cools, examination will disclose porous, spongy-looking globules of oxide on the edges of the hole.

The Murray Lead Smelter



Blast-furnace charge car

J. B. Huttl

Assistant Editor, Salt Lake City, Utah

THE second largest enterprise operated by the American Smelting & Refining Company in Utah is the Murray lead smelter, situated about 8 miles south of Salt Lake City, on the main lines of the Denver & Rio Grande Western and the San Pedro, Los Angeles & Salt Lake railroads. The history and development of this metallurgical plant dates back to 1899, when American Smelting & Refining, after acquiring the old Germania and Hanauer properties at Murray, the Mingo plant at Sandy, and the Ibex plant at Leamington, decided to confine all lead-smelting operations to one large and modern plant, for a more economical treatment of lead-silver ores produced in Utah and neighboring states, which were formerly either smelted in numerous small plants or shipped to the East or abroad. Accordingly, construction of the new smelter was started, and production began in July, 1902.

Efficient elimination of smoke—an important problem confronting every metallurgical concern that operates in an agricultural region—has been accomplished at the Murray lead smelter by the installation of a modern Cottrell plant, improved baghouse practice, and, further, by suspending operations in the arsenic plant and curtailing the roasting of high sulphur-bearing materials during the summer months.

The ore supply from the various mining districts in Utah, and also from California, Oregon, Washington, Idaho, Nevada, and Colorado, including lead-bearing smelter byproducts from the Garfield and Tacoma copper smelters, is delivered in standard railroad cars to the weighing department or scale house, over the tracks of the aforementioned railroads. A modern gas-heated thaw house, accommodating twelve cars at a time, is operated during the winter months.

After being weighed, each shipment of crude ore, concentrate, coke, or limerock is transferred and unloaded over an elevated track system to the corresponding bins, stockpiles, or sample mills. In general, all tramming of material between the different departments is performed by standard-gage switch engines; and steam-driven locomotive cranes, equipped with grab buckets, are employed for loading and unloading wherever necessary. Shipments of crude ore, not yet crushed and sampled at either the Murray sampler of the Utah Ore Sampling Company or at the property from which the ore was shipped, are first delivered to one of the three sampling mills, according to the character of the ore.

Crude sulphide lead ores, also first matte from the blast furnaces, are treated exclusively in mill No. 1. From the receiving bin the material is evenly fed by a pan conveyor to a 15x30-in. Kennedy jaw crusher, and then elevated and passed over a Hum-mer screen, and the oversize passed through two sets of rolls to be further reduced. Then the product is re-elevated and discharged over a second Hum-mer screen. The ⅜-in. undersize of both screens is dumped onto a belt conveyor, and by a third elevator it is again raised to the top of the mill. After a two-stage sample (of one-tenth cut each) is taken, the crushed ore is delivered over a belt conveyor to a system of fourteen mixing bins, arranged in a double row, with an aggregate capacity of 1,400 tons. Three large rectangular hoppers are provided for the storage of high-sulphide and pyrite concentrates. Each individual bin and hopper is equipped with an adjustable apron feeder to facilitate the proportioning of the charge for the Wedge and Godfrey furnaces. From this point the mixed product, consisting of about 75 per cent concentrate and 25 per cent crude ore, passes over a belt conveyor system to the feed floor of the Wedge roasters, or to the main storage bin of the Godfrey roasters when containing much arsenic.

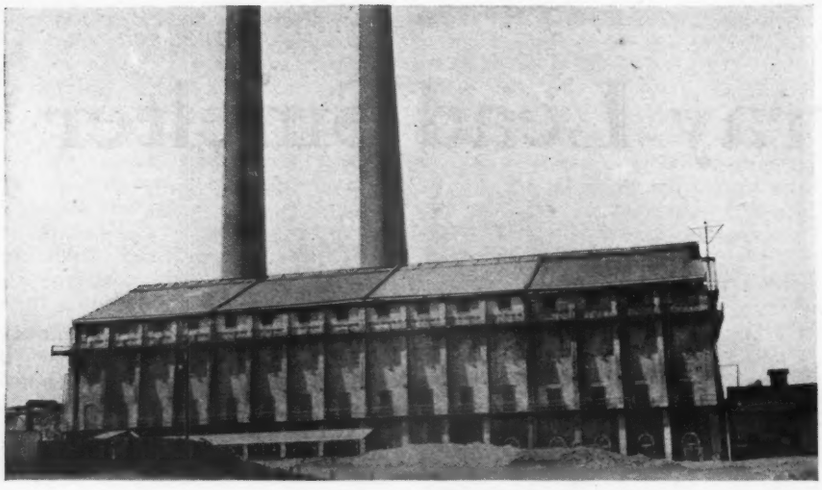
Mill No. 2, with a similar flow sheet, is utilized for the crushing and sampling of lead-oxide ores. One-fifth sample cuts are taken, the coarse and fine rejects being discharged from chutes into standard railroad cars and directly conveyed to the smelting beds. A part of the fines is also delivered to the main Dwight & Lloyd mixing bin. In the eastern section of the mill are a series of hoppers, of 150 tons' total capacity, in which smaller shipments, when pending settlement, can be stored if desired.

Byproducts and extremely wet ores are treated in mill No. 4, equipped with a 24x26-in. Farrell jaw crusher, a belt conveyor system, and a Vezin sampler designed to take a one-tenth sample cut. The coarse rejects are returned to the smelting beds, and the fines delivered to mill No. 1.

Limestone, for fluxing, properly sized at the company's own quarry, is dumped directly into the 500-ton storage bins at the smelter. A reserve stock, however, of several thousand tons, is always kept on the stockpile. Coke for smelting operations is obtained from the ovens of the Columbia Steel Corporation, at Ironton, Utah, and stored in a manner similar to the storage of the limestone.

Concentrates and crude ores of low sulphur content, flue dust, blast-furnace barrings, and fines from mill No. 2, which constitute a part of the charge for the Dwight & Lloyd sintering machines, are delivered in standard railroad cars to the corresponding unloading pockets of the main 1,200-ton storage bin. From the pockets the materials pass over a belt-conveyor system to the top floor of the mixing building, and are deposited by an automatic tripper into a series of sixteen cylindrical mixing bins, of 35 tons' capacity each. These bins, arranged in two rows, are equipped with adjust-

The second of a series of articles on the American Smelting & Refining Company's enterprises in Utah.



Exterior of baghouse

able gates and variable-speed conveyor feeders, to afford facilities for combining the various ingredients of the charge, as desired. The product from the different bins is fed evenly onto a belt conveyor, and after passing through a revolving disintegrator, or mixer, is conveyed to the feed floor of the Dwight & Lloyd building and discharged through a movable tripper into the conical 15-ton feed hoppers, installed above each sintering machine.

All samples taken by various methods in the plant are first delivered to a well equipped bucking room, in the western section of mill No. 2, for final preparation for the laboratory. The laboratory is divided into three sections, containing the necessary equipment for fire and wet assaying, and weighing apparatus. The built-in furnaces are gas-fired, and adequate ventilation is effected by down-draft hoods connected to the main blast-furnace fan.

Ample facilities are provided in the roasting department. The equipment consists of six 22-ft. 6-in. diameter seven-hearth Wedge roasters, with a total capacity of 480 tons per day, for pre-roasting operations; seven standard Dwight & Lloyd sintering machines, used as finishing roasters; and five Godfrey single-hearth furnaces, to treat high-arsenic dust exclusively.

The Wedge furnaces are in a single row and have water-cooled rabble arms and hollow steel center shafts. Natural-gas burners are provided on the third and fifth hearths for starting the roasters and to increase temperatures when necessary. Each furnace is also equipped with four 15-ton hoppers, which weigh and feed the charge evenly onto the top or drying hearth. The gases are discharged through a multiple gas flue into the main hopper-bottom brick flue connected to the Cottrell plant. Calcines from the bottom hearth are dumped into large dump-bottom hoppers, and trammed by an electrically operated lorry car to a brick storage bin, from which point they are, when required, conveyed over a belt conveyor to the Dwight & Lloyd mixing tanks.

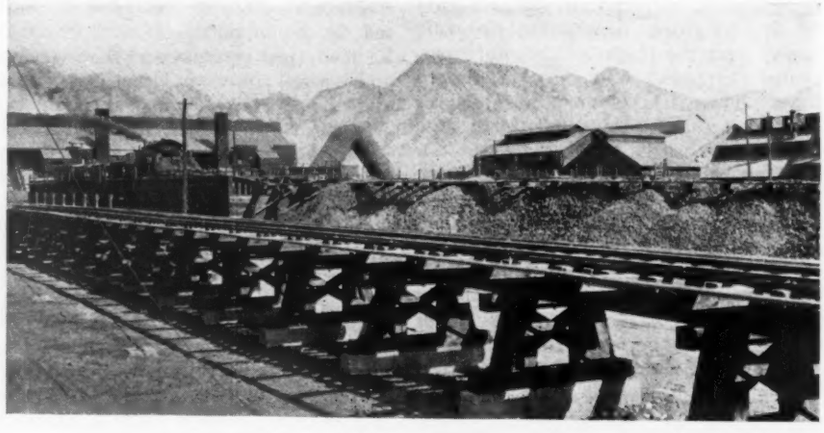
The former practice of using the Huntington-Heberlein pot process in connection with Dwight & Lloyd sintering machines, for finishing roasting operations, has been discontinued; and Dwight & Lloyd machines are now used exclusively for this work. The thoroughly mixed charge from the conical feed hoppers, equipped with revolving Murray mixing and moistening tables, is fed evenly through a spreading cone onto the pallets of the sintering machines. Ignition of the sulphide minerals in the charge is accomplished by Salida stoves in which natural gas is employed as a fuel, the necessary draft being supplied from an exhaust fan driven by a 50-hp. motor directly connected to the wind-box of each machine, effecting a 4-oz. vacuum.

Double sintering is practiced to a considerable extent at this plant. Three to four machines are employed to make the first sinter from a charge made up of ore, concentrate, and plant secondaries, which are least desirable from a sinter-making standpoint. The product of the machines producing first sinter is dumped onto a long steel pan conveyor, is moistened and cooled, fed through two sets of rolls to be crushed to $\frac{7}{8}$ in. and then elevated and passed over a Hum-mer screen. The undersize is belt-conveyed to the corresponding tanks at the mixing plant, from which it is returned, as a part of the charge consisting of 75 per cent of first sinter and 25 per cent sulphide concentrate, to the remaining four machines producing final sinter. Each of these machines treats about 140 tons of dry charge per day, reducing the sulphur content to about 3 per cent in the final sinter, which is directly dumped from the machine into standard railroad cars and transported to the blast-furnace bins. The gases from the sintering machines are discharged into a brick flue system and mixed with the Wedge roaster gases before being treated in the Cottrell plant.

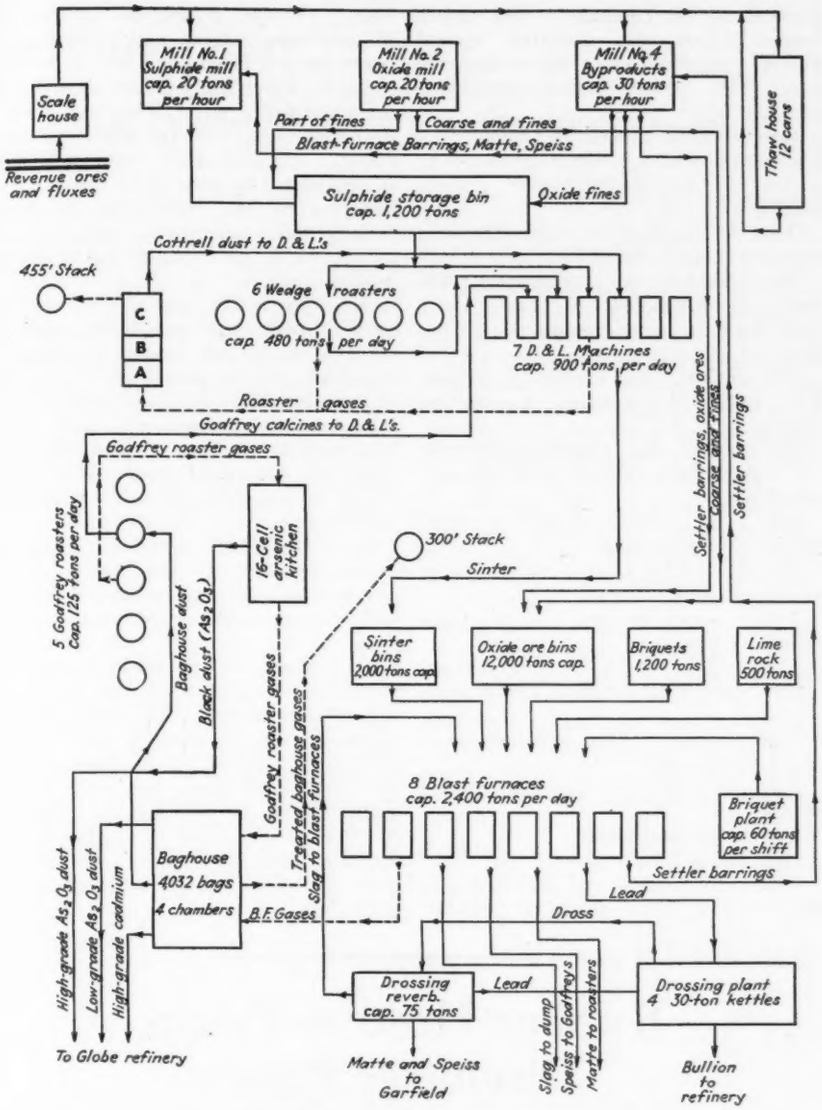
Sulphuric acid vapors can also be injected into the aforementioned flue system from a small gas-fired evaporation plant, whenever necessary.

The Cottrell pipe treater, with a capacity of 250,000 cu.ft. of roaster gases per minute, is divided into three sections. It consists of twenty treating units, each equipped with two hundred 6-in. pipes and wires. The provision of dampers and flues makes it possible to operate the plant in series or in parallel. The gases pass at the rate of 12 ft. per second, thus exposing the particles about two seconds to the electric element, charged with 26,000 volts, and effecting a recovery of 96 to 97 per cent of flue dust. The treated gases are released to the atmosphere through a 455-ft. smokestack. Small narrow-gage mine cars are employed to transport the collected flue dust from the storage hoppers to the Dwight & Lloyd mixing bin.

A relatively new addition to the Murray smelter is the arsenic plant, consisting of five revamped Godfrey roasters, a sixteen-cell arsenic kitchen, and a hopper-bottom brick-flue system. The plant was built about four years ago for the purpose of treating during the winter months accumulated arsenic-bearing flue dust mixed with limited



Storage piles



Flow sheet of Murray lead smelter

quantities of pyrite and concentrate. The Godfrey furnaces, each of which is equipped with two burners, using natural gas as a fuel for starting and to increase temperatures for roasting operations when desired, are installed in a single row, and produce about 125 tons of calcine per day. Small, narrow-gage mine cars are employed to deliver the charge from the main storage bin to the sheet-iron feed hoppers above each roaster, which feed the charge evenly to the center of the brick hearth, revolving at one revolution every 8½ minutes. Air for cooling the shafts and arms, introduced at the top of the rotating shaft, is supplied by a small electrically driven fan. The hot calcine is discharged into a conical hopper equipped with a revolving Murray table on which it is moistened and cooled, and then dumped onto a belt conveyor and conveyed to the Dwight & Lloyd mixing tanks. The roaster gases are discharged through sheet-iron goosenecks into the main brick flue, and with the aid of a large fan, are drawn through the sixteen cells of the arsenic kitchen. This is constructed on the plan of a zigzag flue, in which, because of the friction between the stationary walls and the traveling gas, resulting in a retarded velocity, the dust particles are precipitated and collected at the bottom of each cell. After leaving the kitchen the gases, for a second treatment, are forced through the corresponding section of the baghouse before being released to the atmosphere. The collected black dust, or high-grade arsenious oxide, from the kitchen, also low-grade arsenious oxide and high-grade cadmium from the baghouse, are shipped in standard railroad cars to the Globe refinery in Denver.

The smelting department comprises eight water-jacketed blast furnaces, with an aggregate capacity of 2,400 tons per day. Each furnace measures 48x176 in. at the tuyères, 24 ft. 7 in. from the tuyères to the feed floor, and is operated with a 16-ft. charge column. Air for smelting operations is obtained for each furnace from one main air line, and introduced at 36- to 88-oz. pressure through twenty 4-in. tuyères. Because of the possibility of uneven volume distribution, a recording flow meter is installed at every furnace, which indicates the air conditions prevailing in each, and thus facilitates correction whenever necessary.

Ore, fluxes, coke, and briquets are delivered from the hopper bins, smelter beds, and briquetting plant by Fordson tractors and side-dumping cars to one of two charge sheds. The briquet plant, in which about 60 tons of briquets per shift can be produced, is equipped with a Boyd & White mineral press, to mix and prepare the collected flue dust from the plant and the Garfield and Tacoma copper smelters, for use in the blast furnaces. At the charge sheds the contents of each car are carefully weighed and automatically fed and spread into the charge car, which is on a depressed track in the charging pit. Scrap iron for reduction is added in amounts of 1 to 2 per cent of the charge.

The charge car, containing about five tons of material, is raised 30 ft. by a direct hoisting cable to the feed floor on one of the two inclines of 28 deg., and then placed on a transfer car and mechanically emptied into whichever furnace is to be charged. Slag and matte from each furnace are tapped periodically, first into a large settler, overflowing into a smaller settler, in which lead, first matte, and other secondary matter are separated from the slag by difference in specific gravity. The contents of the settlers in turn are tapped at regular intervals into shallow cast-iron pans, and returned to the various departments, as illustrated in the accompanying flow sheet. Slag is collected in 5-ton ladle cars, which, by the aid of small electrically driven drum hoists, are transferred to the main track, whence they are hauled to the slag dump by a small steam locomotive. This installation obviates the necessity for a second switch locomotive, formerly employed, thus effecting considerable savings.

Lead produced in the blast furnaces is tapped into cast-iron ladles of 1-ton capacity, which are hand-wheeled to four 30-ton gas-fired cast-steel kettles at the drossing plant. All heavy dross, separated from the lead bath by the usual means of cooling and air agitation, is skimmed by hand into a shallow perforated pan suspended over the kettles from an electric monorail crane. When full, the pan is conveyed and emptied into a charge ladle, the contents of which are poured by a second crane into the 75-ton gas-fired reverberatory furnace to be re-treated. The tapped slag from this furnace is returned to the blast furnaces, the lead to the drossing kettles; and the copper-bearing matte and speiss, after being mechanically granulated, is shipped in standard railroad cars to the Garfield

copper smelter. Clean molten lead from the kettles is siphoned through a movable filling pipe into the cast-iron molds arranged in a semicircle, which are then sprayed with water to hasten solidification. The cooled lead bars are afterward marked and loaded by hand labor into box cars for shipment to the refinery.

Blast-furnace gases are drawn off through brick down-takes into a hopper-bottom brick flue, and travel through a sheet iron bypass and a rectangular flat-bottom brick flue, 1,270 ft. long, before entering the fan house. A large Buffalo Forge exhaust fan, the impeller of which measures 15x6 ft., and which is driven by a 75-hp. motor, then transfers the gases into the distributing flue, and, at a pressure of ½ in. water, forces them through the corresponding section of the baghouse.

The baghouse, constructed in 1906, went into operation the following year, and since this date has been considerably improved, especially in regard to bag-hanging and -shaking practice. The brick building, measuring 216 ft. 6 in. x 9 ft. 6 in., and 51 ft. 6 in. high to the roof trusses, is divided into four compartments by three brick partition walls which extend from the floor line to the apex of the roof. Below the thimble floor each compartment again is divided into four chambers, or cellars, each of which is provided with four 8-ft. doors, for removal of the collected dust. The gases from the 16x16-ft. brick distributing flue are introduced into the sixteen chambers by 42-in. hinged dampers made of ¼-in. steel, which are operated through 2-in. pipe stems, and, through a return flue situated above the distributing flue equipped with 34-in. hinged dampers operated by chains on the thimble floor, are released through a 300-ft. stack to the atmosphere. A total of 4,032 woolen bags, each 18 in. diameter and 30 ft. long, furnishing a total filtering surface of 570,012 sq.ft., which filter about 165,000 cu.ft. of gas per minute, are contained in the four treating chambers. Formerly the bags were wired at the top and suspended by the wire from hooks fastened to 3-in. channel irons, and shaken by hand. For this purpose a compartment had to be freed from gas before men could enter. This practice was discontinued some years ago, and now the 42 bags in a row are suspended from a 1½-in. pipe, extending outside the building, to which a lever device is connected to facilitate the shaking. The bags are shaken, a compartment at a time, from three to four minutes every 24 hours. The flue dust is allowed to accumulate in each chamber to a depth of not more than 24 in., to be shoveled in wheelbarrows and dumped into standard railroad cars, to be returned to mill No. 2.

Electric power for operations is purchased from the Utah Power & Light Company, and blast-furnace air is compressed in the company's own power house, which also contains several power-generating units for emergency use. The power house equipment consists of:

One 18x38-in. tandem compound Corliss engine, which is direct-connected to a No. 10 Connersville blower (Nordberg).

Two 20x40x68x48-in. Allis-Chalmers cross-compound Dixon blowing engines.

Two 400-kva. a.c. generators, 480 volt, direct-coupled to two 18-in. and 36x36-in. cross-compound Corliss engines (Nordberg).

One 50-kw., d.c. exciter generator, 125 volt, direct-coupled to marine engine.

One 50-kw. d.c. exciter generator, 150 volt, direct-coupled to 75-hp. a.c. generator.

One I.-R. Imperial, Type 10, steam-driven air compressor.

One I.-R. Class AA-2, steam-driven air compressor.

Two steam-driven Worthington vacuum pumps.

Three Class K 19, Stirling 330-hp. boilers, delivering steam at 150-lb. pressure.

Two steam-driven Worthington boiler-feed pumps.

Two steam-driven fire and service pumps.

One large switchboard.

One 20-ton hand crane.

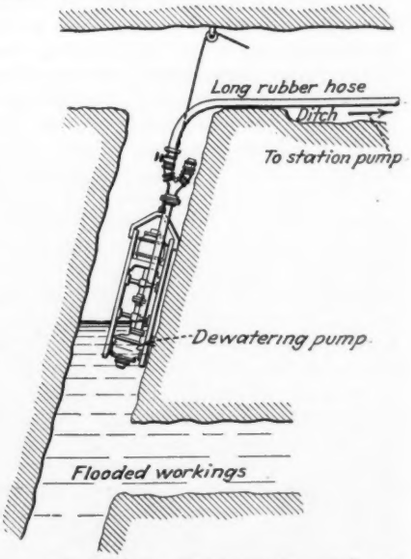
Water for boiler feed and drinking purposes is obtained from artesian wells; for fire protection, cooling of blast-furnace jackets, and general purposes, from a large pond fed by several springs. Electrically driven centrifugal units pump the water from both points into three large storage tanks, of 94,000-gal. capacity each, from which it is distributed by gravity to the various departments. Hot water from the water jackets and condensers is returned by gravity to the pond and cooled by spray nozzles.

All construction and general repair work is performed in a large, modern machine shop, with boiler, blacksmith, electrical, and carpenter shops. Most of these buildings, equipped with traveling and jib cranes and other conveniences to facilitate the handling of materials, are of brick and steel construction and accessible by standard-gage tracks.

A well-equipped emergency hospital is also maintained at the Murray plant. Large, modern change rooms and shower baths are provided. Frequent examination of the men by the company physician and the practice of every precaution have reduced the cases of leading to a minimum. The men, at the slightest sign of leading, are immediately transferred to a different department, away from dust and fumes. Furthermore, the fact that the turnover of labor at this plant is practically nil indicates that everything possible is done for the welfare and safety of employees.

Rubber Hose as Pump Discharge Pipe

AT THE Honerine mine of the Combined Metals Reduction Company, at Bauer, Utah, a standard dewatering pump with a steel-pipe discharge column was employed to dewater a certain flooded part of the mine. Little headway, however, was made because of the length of time required to take the pipe column apart and insert a new length of pipe when the lowest suction level was reached. The inflow of water was such that it had risen almost to the original level, during the shutdown of the pump, before pumping operations could be resumed. This difficulty was overcome by replacing the steel pipe column with a long rubber hose and connecting the hose to one end of the Y-pipe section that was bolted to the short discharge pipe of the pump, as shown in accompanying illustration. The flexibility of the hose permits a gradual lowering of the pump as the water level falls, and only a few minutes are required to disconnect and connect the hose to the new length of pipe, which, in the meantime, had been bolted onto the other end of the Y-section. This procedure is then repeated until the lowest mine level has been reached and a stationary pump installed.



Dewatering arrangement used by Combined Metals Reduction Company, at Bauer, Utah

Wiluna Gold

A New Western Australian Enterprise

ABOUT 300 miles due north of Kalgoorlie, Western Australia's most famous gold field, and about 120 miles due east of Meekatharra, more than 400 men are now engaged in construction work on the properties of Wiluna Gold, under the direction of C. E. Prior, general manager, and H. E. Vail, consulting engineer of the company. Production is expected to start within a year. When capacity operation is reached, an annual output of about £750,000 in gold is anticipated. As Western Australia's production has shrunk steadily within recent years, and in 1929 was equal to only £1,602,-079, the importance of this new producer can be appreciated.

When completed, the Wiluna mill will have a capacity of from 40,000 to 50,000 tons of gold ore monthly, or about the total monthly tonnage now treated at Kalgoorlie. The average grade of the ore is from 30 to 40s. per ton. Mining and treatment costs have been estimated at 19s. per ton. To equip the property, the Western Australian government has advanced the company £300,000, in addition to £300,000 raised by financing in 1928. The company's capital is now 1,000,000 shares of £1 par, all issued.

Known ore reserves of the mine are 1,500,000 tons. This includes ore to shallow depths only and can probably be greatly increased. The company has extensive plans for exploration of orebodies on its holdings, which total 793 acres.

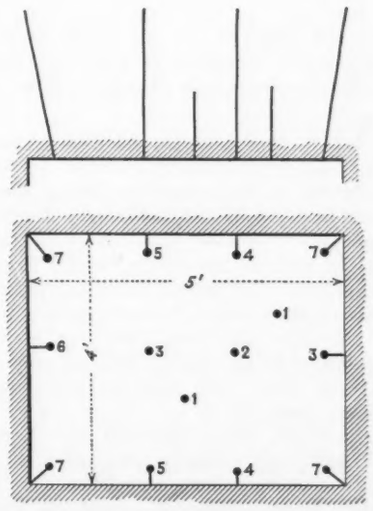
The ore is largely sulphide and it is contained within two main zones, about 800 to 1,000 yards apart, extending for a length of 1½ miles. Diamond drilling was started in 1924. Results were so encouraging that in 1927 and 1928, pilot metallurgical plants were built to permit of large-scale sampling. Returns from these plants exceeded expectations, and the decision to equip the property was reached.

The orebody in the east zone has been proved for a distance of 1,700 ft. Its width varies from 4 to 50 ft. Average grade is about 40s. per ton, and ore has been proved to a depth of 500 ft. The orebody in the west zone is 1,200 ft. long, with widths ranging from 3 to 36 ft. Average grade is slightly lower than in the east zone. Its continuation in depth has been proved only to 300 ft. A main hoisting shaft, situated between the two lodes, is being sunk to a depth of 800 ft. At last report it was considerably below the 600 level. Haulage levels are being driven at 290 and 450 ft. Crosscutting to the western orebody at the latter depth has been started and may add considerably to reserves. Ore will be hauled by five-ton electric storage-battery locomotives to the shaft for hoisting. The locomotives are capable of hauling a train made up of fifteen two-ton cars.

Hoisting will be done in four-ton skips and ore will be dumped directly from the skips into a 20-in. gyratory crusher that will reduce it to 4-in. size. After further crushing in two Symons cone crushers, the ore will be conveyed by a 600-ft. 24-in. rubber belt to the four 1,200-ton cylindrical steel ore bins. Each bin will feed a grinding unit, consisting of a Hardinge conical ball mill, Dorr classifier, and two tube mills, 22 ft. by 5 ft. 6 in. Ore will be ground to minus-200 mesh and will be thickened in Dorr traction thickeners before entering the flotation department, in which a 10:1 concentrate will be made. After filtering, washing, and drying, the concentrate will be roasted in five Edwards-type roasters and made amenable to cyanide treatment. The Merrill-Crowe vacuum process will be used in treating the gold-bearing cyanide solution. Installation of milling machinery was started in March.

Wherever possible, electricity will be used for power. For this purpose 540-hp. Diesel engines will be used to drive 450-kva. alternators. Three Belliss & Morcom compressors, driven by 400-hp. Crossley-Premier oil engines, will supply air for drilling operations. About 6,000 tons of crude oil will be consumed as fuel annually. In addition to ten 5,000-gal. iron tanks at the mine, for oil storage, the company will build a large tank at the port of Geraldton that will hold 9,000 tons of crude oil, or enough for eighteen months of operation. The fuel will be transported to the mine from Geraldton in 5,000-gal. railroad tank cars. The Western Australian government extended the railroad from Meekatharra to Wiluna to provide transportation facilities essential to operation.

New Blasting Method Proves Satisfactory



Raise round, with numbers in the order of firing

ON THE property of the Harmony Mines Company, at Baker, Idaho, the same type of blasting round is used in all raises, according to R. Duncan Gardner, who describes underground practice there in U. S. Bureau of Mines Information Circular No. 6240. This round is a departure from the usual practice but works well in every kind of rock in which it has been tried. Its superiority over the ordinary round is marked in exceptionally hard ground. It consists of the usual number of holes drilled nearly parallel to each other straight into the face. In addition to these, two short holes one-half the length of the other holes are drilled diagonally across the middle holes of the round.

The illustration herewith presented shows the position of the holes for a 5½-ft. round. The short holes break well and form a cavity in the center of the face. Consequently, the remainder of the round has a fair chance of breaking to this center cavity. A 3x4-ft. raise has been driven through hard limestone and advanced an average of 5 ft. per round when this style of round is used. In such a small raise much pitch cannot be given to cut holes; but, by drilling seven long holes and two short ones, no difficulty was experienced in putting in the rounds, and each broke to the depth of the holes drilled. The raise crew consists of a miner and a helper.

Status of the Porphyries—
Present and Prospective

"The King is dead! Long live the King!" is not inexpressive of the attitude adopted by some writers on matters concerning the copper industry when considering the respective positions of the United States and Rhodesia in production of the red metal. But is the United States rapidly exhausting its reserves of copper? Will this country soon be faced with the prospect of relying on foreign sources for a large part of its copper requirements? The porphyry mines of the West have for the last twenty years played an increasingly important part in the copper industry. An examination of their present position reveals no cause for alarm on their account, at least.

S. D. Strauss
Assistant Editor

THE copper deposits now under intensive development in Northern Rhodesia are generally expected to supply a large part of any future increase in world copper consumption. So great is the interest in the new field that mining engineers and mine operators who visit it rarely return without giving vent to at least one statement in which their individual opinions on the potentialities of Rhodesia are expressed. Possibly the enthusiasm that Rhodesia has evoked emanates at least partly from the great adventure that its recent past has been and that its future promises to be. New towns are being built, new railroads are being laid, and an industrial empire is being carved out of the heart of Africa—an undeveloped continent. By contrast, the copper-mining industry in the United States is a staid and settled enterprise. Some prophets, among whom may be listed Prof. L. C. Graton, of Harvard, even feel that if it has not already passed its zenith, it is certainly approaching that point.

TO contradict this impression would require more statistical evidence than is probably available. The 1929 annual reports of some leading United States copper producers, however, do not indicate that their ore reserves are being depleted at an alarming rate. Particularly is this true of the so-called porphyry mines, of which nine are now in operation—Utah Copper, Nevada, Ray, Chino, Morenci, New Cornelia, Miami, Inspiration, and Consolidated Coppermines. The accompanying tabulation lists the published ore reserves of these companies, and also both potential and actual output. Several interesting conclusions can be drawn from the compilation.

In 1929, the United States porphyry mines added to their reserves at least 169,782,000 tons of ore, containing about 1,761,000 tons of copper. Their production in the same year was the highest, collectively, in their history. None of this additional tonnage represents reserves recalculated because of the increase in the price of copper. Every ton is material that has been added to reserves by development work.

AT the end of 1929, the total amount of copper contained in the known reserves of the porphyry copper mines was at least 17,685,000 tons. This is equal to seventeen years of production at the rate of the entire United States output in 1929, which was the highest rate in the history of the United States.

In 1929, the nine porphyry mines produced about 438,000 tons of copper. At this rate, their reserves would last about forty years.

By 1934, when Morenci will bring its new Clay orebody into production, the porphyry mines will have a minimum potential output of 651,000 tons of copper annually. At the end of 1929, potential annual output of the porphyry copper mines was 577,000 tons. In addition to Morenci, only Consolidated Coppermines has committed itself to a program of plant expansion in the future. But even at the increased rate of production made possible by the potential capacity in 1934, the porphyry copper mines would have more than twenty-five years of known life ahead of them on the basis of present reserves.

At present, if necessary, the porphyry mines could produce 139,000 more tons of copper than in 1929. By 1934, they will probably be in a position to produce 213,000 more tons than in 1929.

EVEN compared with Rhodesia, the showing is not so bad. Not more than three Rhodesian mines are expected to be in production by the end of 1934, according to present plans. Their potential output at that time will be about 180,000 tons of metal annually.

Figures used in preparing the table are in nearly every case official. Where they are not official, conservative estimates have been made, and the fact will be noted in the remarks on the individual mines that follow.

Utah Copper, of course, still heads the list. According to the company's annual report, the additional tonnage developed during the year was found in the northern and western sections of the property by churn drilling. L. S. Cates notes that "drilling operations will continue for several years, with every assurance that additional ore will be developed." Utah's reserves today are the greatest in its history, although since 1906 184,000,000 tons of ore have been extracted.

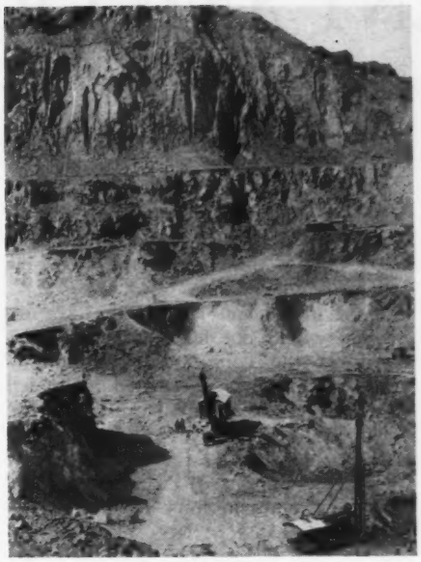
Nevada Consolidated undertook development work at only one of its

properties during 1929—Chino, in New Mexico. The new tonnage developed there, however, was more than the total mined at all three properties. A complete calculation of the additional ore shown has not been made and will not be made until further drilling has been carried out. More than 20,000,000 tons is known to have been proved, however, and further material increases are expected.

The largest individual increase in ore reserves during the year among this group of mines was made at the Morenci branch of Phelps Dodge. There the intensive campaign of exploration on the so-called Clay orebody has been concluded. In addition to the 245,000,000 tons definitely blocked out, the probability exists that reserves can be greatly augmented when necessary and desirable. In the meanwhile, ore for 25 years of operation of a 25,000-ton plant is in sight, and Phelps Dodge is proceeding with construction of a plant of that size. It will start producing in 1934, when present reserves of the higher-grade Humboldt orebody will be nearing exhaustion. No figures for this orebody are included in the report, but on the basis of five years of production at the present rate, I have estimated 8,500,000 tons of 1.9 per cent grade.

No new estimate was made for reserves at New Cornelia in the annual report of Calumet & Arizona Mining, the parent company. In the table the reserves are shown as unchanged from last year. This presumption is based on the statement by M. Curley, general manager of the property, that six diamond-drill holes completed during the year have developed a "substantial tonnage of sulphide ore." Other additional tonnages of both carbonate and sulphide ores were encountered in developing the new approach to the pit.

Miami Copper developed no new ore during 1929, and consequently the reserves have shrunk by the tonnage mined. This mine, incidentally, is the only one in the porphyry group that reports failure to develop new ore. The reason for that failure is not hard to find. No development work was



done. At the increased rate of production put into effect last fall, reserves are sufficient for sixteen years.

The last estimate of ore reserves at Inspiration Consolidated was published in 1926. Last year, the company acquired the adjoining Southwestern Miami property. The fact that ore is now being mined from Southwestern Miami ground is sufficient proof that reserves were increased by that step.

Figures given for Inspiration in 1928 are the 1925 estimate, minus the tonnage of ore mined between those two years. The estimate given for 1929 is the same as that for 1928, the presumption being made that the Southwestern Miami area added at least one year to the property's life.

The Globe-Miami district, in which Inspiration and Miami are situated, is known to have large additional tonnages of porphyry ores of a lower grade than those now being mined. The total capacity of the Inspiration property, shown in the table, is estimated at 28,000 tons of ore daily, or about 95,000 tons of copper a year. This estimate, which is of metallurgical capacity only, is based on the 20,000-ton concentrator and 8,000-ton leaching plant with which the mine is equipped. Recently, only eight or nine sections of the twenty sections in the concentrator have been used, at most. Whether or not the mine is equipped to produce as large a tonnage as 28,000 tons daily is questionable.

Consolidated Coppermines has put its mine in a position to produce at least 9,000 tons of ore daily. At present, about 3,000 tons of concentrating ore and 300 tons of direct-smelting ore are being handled daily in the metallurgical works of the adjoining Nevada Consolidated property. In the Coppermines annual report, H. D. Smith, president of the company, states that "additional treatment facilities must be arranged for these ores at the earliest practical date." Whether this means the construction of an independent plant by the Coppermines company or simply an additional contract with Nevada Consolidated is hard to say. The relations between the two companies have been strained by litigation over mining rights. At present, Nevada has completed remodeling of its concentrator to bring effective capacity up to 18,000 tons of ore daily. In the table this has been shown as 15,000 tons from Nevada and 3,000 from Coppermines.

As for ore reserves at Coppermines, 11,000,000 tons has been added by recent churn drilling, which is being continued. Further additions to existing ore reserves can be confidently expected in the porphyry area, according to J. B. Haffner, general manager. The company is also developing some high-grade sulphide deposits, but no estimate on the tonnage proved has been made.

This summary includes only producing porphyry mines. It takes no cognizance of at least two properties that will probably enter production—Hammon Copper and Bagdad Copper—with fairly large reserves. But of interest is the fact that wherever development work is being done additional ore has been found. I do not wish to intimate that the process can continue forever. But the record of the United States porphyry mines within the last year certainly should demonstrate that copper reserves in this country are not yet on the wane.

Porphyry Copper Mines in the United States

(All tonnage figures in thousands of tons)

Mine	Reserves, End of 1929 — Ore (tons)	Grade (% Cu)	Copper (tons)	Reserves, End of 1928 — Ore (tons)	Grade (% Cu)	Copper (tons)	Daily Tonnage — 1929	Daily Tonnage — Capacity	Annual Output, Tons of Copper — 1929	Annual Output, Tons of Copper — Capacity
Utah	640,000	1.07	6,848	625,000	1.066	6,662	50	60	148	180
Nevada Ray Chino	273,500	1.51	4,128	267,000	1.51	4,031	14 (a) 10 11	15 (a) 12 15	133	175
Morenci	245,000 8,500	1.12 1.9	2,905	111,211	1.44	1,501	.. 5	25 ..	... 27	83 ...
New Cornelia	113,262(b)	1.25	1,415	113,262	1.25	1,415	10	15	36	50
Inspiration	81,000(b)	1.40	1,134	81,000(b)	1.40	1,134	16	28(b)	54	95 (b)
Miami	97,391	0.95	925	102,398	0.95	972	14	17	29	36
Con. Copper	30,000	1.10	330	19,000	1.10	209	3(a)	9(a)	11	32
Totals	1,488,653		17,685	1,318,871		15,924			438	651

(a) Adjusted to allow for overlapping. (b) Estimated on the basis stated in article.

COMMENT AND CRITICISM

Low-Grade Gold-Ore Treatment

To the Editor of "E.&M.J.":

At various times recently the contention has been raised that insufficient attention has been paid, and is being paid, to the possibility of stimulating the mining of large low-grade gold deposits by working them by methods similar to those employed in the mining and beneficiation of low-grade copper "porphyries." Speaking from the millman's point of view, the feasibility of handling large tonnages profitably depends primarily on the economic degree to which crushing would have to be carried. This indicates research work, to determine in what form the gold occurs, whether it is free or associated with minerals, and the coarseness of crushing permissible. If the low-grade deposit calls for all-sliming, this will probably baffle all attempts to work it at a profit. Success will lie possibly in crushing to coarse-sand size, separation for cyanidation of the sand in vats of large capacity, and the flotation of the concentrate in the slime overflow for separate cyanidation.

The avoidance of amalgamation is, I think, entirely practicable when dealing with low-grade ores. One gold ore with which I was at one time acquainted yielded a markedly higher extraction when it was cyanided after a preliminary baking by heating to 100 deg. C. This baking could be tried on the flotation concentrate. Since cyanidation came into general use, a great deal of attention has been paid to it, and the metallurgy is well understood. The success of large-scale milling of low-grade gold ores stands or falls with the permissibility or otherwise of coarse crushing.

Much "useless grinding" is done in gold and silver mills; I mean that a large percentage of gangue is invariably overground because such overgrinding of the ore as a whole is necessary to comminute the sulphides to the necessary fineness. I have at times thought that much of this useless grinding can be avoided in some instances by introducing tabling after classification. This would enable much of the sand to be diverted from the fine-crushing equipment. If, however, the ore is comparatively rich in sulphides, and the gold and silver are associated with them—not unusual with silver ores of good grade—the attempted removal of the sand may not prove economic, owing to entanglement of the sulphide particles, which do not yield their precious metals readily unless finely ground. This trouble I do not think would be met in a low-grade gold ore.

Experimentation along the lines indicated would not be costly when one considers the considerable amount of gold that still lies untouched in known low-grade deposits capable of producing enormous tonnages. The test work could be done under the supervision of the U. S. Bureau of Mines, aided by voluntary contributions of parcels of ore by interested parties. The possession of gold is necessary for the credit of a nation, and there seems to be no valid reason why efforts to produce it should not be aided by the state, at least in so far as financial assistance to the Bureau is concerned. A certain inertia in regard to the mining of low-grade gold deposits would have to be faced and overcome. The industry has become so accustomed to plus 90 per cent recoveries that a lower yield, even though economic, would probably give rise to an uncomfortable sensation of loss. Attention has been focused so long on the production in terms of dollars per ton that it would be hard at first to think in terms of cents. Then, again, the average investor does not like too small a margin between total costs and net profit per ton, despite the fact that increased tonnage with cheaper mill costs, the result of coarser grinding, may leave him better off after all.

New York. PAUL T. BBUHL.

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"Engineering Ethics and Promotion Practices"

To the Editor of "E.&M.J.":

Referring to the letter on "Engineering Ethics and Promotion Practices" by Edgar Bush, which appeared in your April 7 number, I think all his questions may be answered simply and easily.

I see no reason why a mining engineer should not make reports on properties in which he is financially interested. In fact, such action is frequently desirable or necessary. And, whatever his interest may be, whether a participation as compensation for his report, a promotion interest, ownership or any other form of interest, and whether the report is addressed confidentially to a friend or is available to the whole wide world, only one course should be followed, no more and no less, and that is: The report should state clearly that he is financially interested in the property. He has then done his duty to himself, his friends, and to anyone who may read the report. This action warns them all that the report is subject to those imperfections that may result from the financial interest he has in the property. His friends will know the probable extent of error, if any; his enemies wouldn't believe him anyway; and strangers can use their own judgment.

The industry needs more engineer-promoters and fewer of the common type who know little or nothing about the business. Every successful mine was promoted by some one, engineer or layman, who had to expend much energy and enthusiasm to arouse interest in the property and to raise capital. After all the information readily available about a property has been obtained and the probabilities of the property have been estimated, a considerable, and frequently a large, element of chance is involved in the promotion, and courage and optimism are needed to proceed with it. Undue optimism is, of course, difficult to avoid in the preparation of a report on a property in which one is financially interested; but it can be avoided, and is avoided. But, in any event, I wou'd rather have a report by an interested engineer that presents clearly essential facts and probabilities, so that I could form some sort of opinion of my own, even though the report might end in a blaze of optimism, than the well-known common type of report by disinterested engineers that presents a mass of detail and frequently a hedging opinion, leaving me wondering whether the property can possibly be worth consideration.

No complicated code of ethics is necessary for the guidance of the mining engineer in writing reports. All he has to do is to write the kind of report he likes to read. If it is in his nature to write crooked reports, no code of ethics would prevent him from doing so. Most of the alleged mining reports are similar to most of the moving pictures, in that it isn't their morals but their stupidity that offends us.

F. E. CALKINS,
Consulting Engineer.
Hollywood, Calif.

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The Carson Patent Profits

G. C. Carson writes correcting a statement in the issue of April 7 that "total payments for infringement [of his reverberatory patent] are said to aggregate about $15,000,000." The amount, according to Mr. Carson, was a little

over $4,000,000. The costs of collection totaled about 25 per cent of this sum. About 80 per cent of the remainder went to those who aided him in carrying on the litigation and to meet his own expenses throughout that protracted period.

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The Decline in the Production of Gold

To the Editor of "E.&M.J.":

Regarding the letter by S. D. Strauss, in *Engineering and Mining Journal* of April 24, on the decline in the production of gold, one point he did not discuss has, I think, a great deal of influence, if not the greatest bearing, on the decline in gold production of this country. That is that, since the War, it has been next to impossible to get anyone to invest in gold mines; not because there are not good properties available but because there was so much more money to be made on the stock market. It seemed that the whole world turned to gambling after the War, and by playing the market some speculators were able to make large amounts of money, first from the stock market and then by reason of the fluctuation in the price of metals. Now that the crash has come in the stock market, which was bound to come sooner or later, and the crash as you may call it, has also come in the copper market as well as in the markets of all other base metals, it may be possible in the next year or so to get people to pay a little attention to an increase in the production of gold.

No doubt some way will have to be found to encourage the production of gold, because with the present output we are not producing enough to take care of the consumption in the arts, let alone in coinage, and as the whole world has gone on a gold basis we will need additional gold. I do not think that for the present anything need be done in the way of bonuses. The only thing the gold industry needs is the interest and co-operation of people with money to invest, who will turn their attention to the development of gold properties. Experience has proved that rarely does a good mining district entirely "play out." What are commonly termed blind ledges can be mined if the company does a legitimate amount of development. If all the profits are not paid out in the form of dividends, most mines would have much longer lives.

So, we will hope that the investing public, a large one in this country, will be interested in assisting in the development of legitimate gold properties, of which there are many awaiting exploitation. A. H. Oleson.

Deadwood, S. D.

To the Editor of "E.&M.J.":

In the very interesting article, "Gold Production in the United States," by S. D. Strauss, the suggestion is made that the chief reward for good management, aside from the salary received, is in the publication of results obtained. I am encouraged, therefore, from purely personal motives, to call attention to the curve on p. 412 showing the cost and grade per ton of ore at the North Star mine during a period when I was manager. The curve serves the purpose of the article perfectly well, but, as will be explained, is too high as a whole.

In 1915, after some investigation, a sorting plant was installed at the North Star, by means of which about 25 per cent of the ore was sorted out as waste before going to the primary crushers. This operation (including primary crushing) cost about 30c. per ton of waste sorted out, and, as the total cost of ore treatment and tailing disposal was about $1 a ton, it obviously increased the milling capacity and at the same time effected a saving in costs. But, if the total costs of mining and milling are divided by the number of tons crushed after the waste has been sorted out, the cost per ton will be higher than it was before the sorting plant was installed. This was what was done to arrive at the values shown on the curve. The figures were doubtless taken from the annual reports of the company, which, while mentioning the number of tons of ore mined and sorted out, state most of the costs and values in terms of "per ton crushed." In general, both the curves are about 25 per cent high. In 1922, for instance, a year when the plant ran at full capacity, the cost was $6.12 per ton, instead of $8.13, and the value $7.08, rather than $9.44.

The high peak in 1920 was caused by operating the mine at greatly reduced capacity. Arthur B. Foote.

Grass Valley, Calif.

Patents

Dust Collector. No. 1,753,503. April 8, 1930. W. G. Clark, Chicago, Ill.

Design for a conical settler.

Mine Tie. No. 1,753,534. April 8, 1930. J. J. Ross, Huntington, West Va.

A reinforced mine tie, made of light metal.

Grinding Mill. No. 1,753,685. April 8, 1930. P. Bodenstein, assignor to Krupp Grusonwerk, Magdeburg-Buckau.

Arrangement for discharge for tube and ball mills.

Electric Furnace. No. 1,753,822. April 8, 1930. G. C. Cox and H. M. McIntyre, Raleigh, N. C.

Design for an electric furnace for electrolysis of fused electrolytes.

Pneumatic Hammer. No. 1,753,910. April 8, 1930. H. W. Weibull, assignor to Nordiska Armaturfabrikerna, Stockholm, Sweden.

Design for a pneumatic striking or hammering tool.

Nickel Metallurgy. No. 1,754,125. April 8, 1930. S. C. Smith, London, England.

A process for depleting nickel sulphate solutions by electrolysis.

Dust Settler. No. 1,754,126. April 8, 1930. A. Stievenart, Boitsfort, Belgium.

Design for a centrifugal dust settler.

Recovery of Metals. No. 1,754,169-170. April 8, 1930. F. Johannsen, assignor to Krupp Grusonwerk, Magdeburg-Buckau.

Process for recovering volatile metals by treatment of ores, slags, and other metallurgical products in a revolving furnace.

Rock Drill. No. 1,748,953. March 4, 1930. L. W. Greve, assignor to Cleveland Rock Drill Company, Cleveland, Ohio.

Design for a valveless rock drill.

Zinc Metallurgy. No. 1,749,127. March 4, 1930. E. H. Bunce and G. T. Mahler, assignors to the New Jersey Zinc Company, New York, N. Y.

Furnace for treatment of zinciferous material containing lead.

Rock Drill. No. 1,750,323. March 11, 1930. E. B. Lear, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for valve for a fluid-activated rock drill.

Mining Prop. No. 1,752,101. March 25, 1930. H. Meutsch, Essen, Germany.

Design for an adjustable mining prop.

Drill. No. 1,753,249. April 8, 1930. G. C. Pearson, assignor to Gardner-Denver Co., Denver, Colo.

Design for a tool retainer.

Magnesium Metallurgy. No. 1,749,-210-11. March 4, 1930. H. H. Dow and E. O. Barstow, assignors to Dow Chemical Company, Midland, Mich.

Process for electrolytic production of magnesium from dolomite and magnesian limestone.

Drill Sharpener. No. 1,749,957. March 11, 1930. P. A. Nelson, assignor to Gardner-Denver Company, Quincy, Ill.

Design for a drill sharpener.

Process for Separation of Minerals. No. 1,749,371. March 4, 1930. J. Bland, Tinton, S. Dak.

Design for an air separator.

Excavating Dipper. No. 1,751,745. March 25, 1930. W. E. Miley, assignor to Marion Steam Shovel Company, Marion, Ohio.

Design for an excavating dipper for a steam shovel.

Zinc Metallurgy. No. 1,751,778. March 25, 1930. C. v. Girsewald and H. Neumark, Frankfurt a/M., Germany.

Zinc oxide is reduced at low pressure with a reducing metal and recovered by distillation.

Electric Furnace. No. 1,751,856-912 and -913. March 25, 1930. A. E. Greene, Seattle, Wash.

Design for an electric induction furnace for smelting metals.

Tantalum. No. 1,754,453. April 15, 1930. C. W. Balke, assignor to Fansteel Products Company, North Chicago, Ill.

Process of removing carbon from tantalum by heating in vacuum with metallic magnesium.

Zinc Metallurgy. No. 1,755,076. April 15, 1930. A. Roitzheim and W. Remy, Berlin-Oberschoneweide, Germany.

A retort furnace for reduction and distillation of zinc.

Digest of Current Technical Literature

Selected from abstracts of articles in the leading technical periodicals, prepared by Engineering Index Service, American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

Asbestos Plants: Electric Equipment—A New 4,000 Ton Asbestos Mill. J. R. Mole. *Elec. News,* Vol. 39, No. 3, Feb. 1, 1930.

ASBESTOS Corporation's latest addition at Thetford Mines, P. Q., known as "Beaver," is completely and thoroughly electrified for hoisting, crushing, drying, and milling; plant uses over 6,600 hp.—E.I.S., New York.

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Blasting Fuses—Some Tips for Blasters on the Lighting of Fuse. F. P. Griswold. *Eng. and Contracting,* Vol. 69, No. 3, March, 1930.

SUGGESTIONS by technical representative of E. I. du Pont de Nemours & Company; fuses, fuse lighters.—E.I.S., New York.

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Copper—Developments in the Metallurgy of Copper. *Metal Industry,* Vol. 36, No. 3, Jan. 17, 1930.

ADVANCES in knowledge of copper are discussed and new fields opened up for its applications described; sources and production; electric conductors; engineering applications; silicon-copper alloys; architecture and building uses.—E.I.S., New York.

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Chalk Quarries and Quarrying: Blasting—Mining of Chalk with Aid of Explosives. *Tonindustrie-Zeitung,* Vol. 53, No. 53, Nov. 25, 1929.

RESULTS of tests which demonstrated advantages of blasting in chalk quarries on Island of Ruegen; saving in labor is effected without increased hazard, provided safe explosives, such as ammonite, are employed.—E.I.S., New York.

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Copper Refining: Electrolytic—Refining Metals by Electrolysis. H. W. Hough. *Sci. Am.,* Vol. 142, No. 3, March, 1930.

DISCUSSION of production of refined zinc and copper by electrolytic process in Anaconda Copper Mining Company's plant near Great Falls, Montana; brief description of plant operation.—E.I.S., New York.

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Lead—Plumbum Nigruni. S. J. Nightingale. *Metal Industry,* Vol. 36, No. 3, Jan. 17, 1930.

BOTH new and ancient applications of lead are described; pipes and sheet; chemical lead; cable sheathings; glazing bar sheathings; accumulators; lead mattresses; ternary alloys of lead; uses of lead alloys; decorative lead work—E.I.S., New York.

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Mine Surveying: Gyroscopic Compasses—Development, Operation, and Use of the Gyroscopic Compass in Mining. W. Seelis. *Bergbau,* Vol. 42, No. 50, Dec. 12, 1929.

ACTION of gyroscopic compass is described and its use in mining operations discussed. —E.I.S., New York.

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Copper Mines and Mining: Arizona—Development and Mining Methods. J. F. Cowley and T. W. Quayle. *Min. Congress Jl.,* Vol. 16, No. 4, April, 1930.

DESCRIPTION of practice at United Verde mine; drifts and raises; determination of mining method; horizontal cut and fill stoping is most widely used; incline cut and fill; overhead square set and fill; incline square set stoping; shrinkage stoping; rock drills, drill steels, and steel sharpening; air and water hose; explosives and fuse; pumping and drainage.—E.I.S., New York.

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Docks: Potash—Potash Dock of Port of Bremen. E. Overbeck. *V. D. I. Zeit.,* Vol. 74, No. 10, March 8, 1930.

DESCRIPTION of specially equipped dock 280 m. long, also of storehouse having capacity of 20,000 sacks, and 6 warehouses of 20,000 tons' capacity each; details of materials handling, loading and unloading conveyors and other equipment having total loading capacity of 480 tons per hour.—E.I.S., New York.

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Mine Hoists: Electric—Determination of Mechanical Losses in Shaft Hoisting Equipment. A. Vierling. *Elektrizitaet im Bergbau,* Vol. 5, No. 2, Feb. 22, 1930.

DETERMINATION of mechanical losses of shaft of Wilhelm Mine in Clausthal with equipment driven by induction type of motor; depth 593.4 m., double-deck cage weighs 1,500 kg. empty and has 3,015 sq.m. surface space in total; gear rate, between drum and motor is 1:20.2; motor is 160 kw. at 585 r.p.m.—E.I.S., New York.

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Ore Crushing Plants: Arizona—Smelter Crushing Plant. P. C. Keefe. *Min. Congress Jl.,* Vol. 16, No. 4, April, 1930.

BRIEF notes on history of ore crushing for smelter of United Verde Copper Company; duty of plant is different from that of average crushing plant, as it must deliver to roaster storage bins mixture of ore almost ready to be smelted; flow sheets of coarse and fine crushing plant are given.—E.I.S., New York.

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Rock Drills: Interchangeable Bits—Development and Installation of the Hawkesworth Detachable Bit. C. L. Berrien. *Min. Congress Jl.,* Vol. 16, No. 3, March, 1930.

PAPER read before Western division of Am. Min. Congress, covering ground similar to A.I.M.E. Technical Publication No. 274, February, 1930, previously indexed.—E.I.S., New York.

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Zinc Ore Treatment: Waelz Process—Zinciferous Slags and the Waelz Process. W. Stahl. *Chemiker-Zeitung,* Vol. 53, No. 8, Jan. 25, 1930.

METHOD of recovering zinc by treating slag with coke in rotary kilns is described; during this process deposits containing considerable proportion of metallic iron are formed in the kilns.—E.I.S., New York.

•

Geology: Rhodesia—The Geology of Southern Rhodesia. H. B. Maufe. *S. African Min. and Eng. Jl.,* Vol. 40, No. 1995, Dec. 21, 1929.

CONCISE summary of stratigraphic and structural conditions; large areas covered by granite and Pre-Cambrian rocks; economic and other minerals; correlation with established South African systems. Abstract of second edition of Outline of the Geology of Southern Rhodesia, by director of Geological Survey.—E.I.S., New York.

Sand and Gravel Plants: Michigan—Michigan Gravel Plant's Method of Excavation Changed to Meet Variations in Deposit. *Pit and Quarry,* Vol. 19, No. 13, March 26, 1930.

HISTORY of Jonesville Gravel Company, Jonesville, Mich., alterations in plant design, including replacement of steam shovels by drag scraper.—E.I.S., New York.

•

Mines and Mining: South Africa—Mineral Resources of South Africa and Their Utilization. H. Reisch. *Berg und Huettenmaennisches Jahrbuch,* Vol. 78, No. 1, Feb. 15, 1930.

NOTES on geology of South Africa and history of mining; genesis of minerals; description of gold, platinum, and diamond mines and mining.—E.I.S., New York.

•

Zinc Ore Treatment: Electrolytic—Study of Influence of Current Density and Temperature on Zinc Electrolysis. P. Roentgen. *Metall und Erz,* Vol. 26, No. 24, Dec. 2, 1929.

FACTORS which influence hydrogen overvoltage, especially current density and composition of electrolytes, are studied from viewpoint of their effect on commercial electrolytic treatment of zinc ore; it is possible to operate with higher temperatures than has generally been thought possible, that is, if current density is sufficiently high.—E.I.S., New York.

•

Rhenium—Rhenium Metal and Its Compounds. *Chem. Age.,* Vol. 22, No. 562, April 5, 1930.

ELEMENT Rhenium, which has atomic number 75, was discovered about five years ago and is now definitely established and element is found to have its place in Periodic System under manganese; properties of metal.—E.I.S., New York.

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Ore Treatment: Flotation—Modern Theories and Investigations of Flotation. S. Mortsell. *Teknisk Tidskrift,* Vol. 60, No. 10, March 8, 1930.

BIBLIOGRAPHY for article previously indexed from Feb. 8, 1930, issue of same journal.—E.I.S., New York.

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Gold Refining: Electrolytic—Electrolytic Gold Refining. E. Downs. *Metal Industry,* Vol. 36, Nos. 5 and 6, Jan. 31 and Feb. 7, 1930.

FUNDAMENTAL reactions in refining gold are described; factors affecting gold chloride concentration; anode solution using direct current only; ratio a.c.: d.c. employed in practice; cathode deposit; fine gold yield; circulation and electrolyte; composition of anode; anode slime.—E.I.S., New York.

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Diesel-Electric Power Plants: British Columbia—The Selection of a Mine or Mill Power Plant. G. R. Frizell. *Can. Min. Jl.,* Vol. 51, No. 14, April 4, 1930.

NOTES on power plant of Base Metals Mining Corp. at Field, B. C.; two 400-hp. six-cylinder, Fairbanks-Morse Diesel engines, each direct connected to 375-kva.

alternator; one 180-hp., three-cylinder, Fairbanks-Morse Diesel engine direct connected to 150-kva. alternator, with alternator shaft of last mentioned engine extended through outboard bearing and connected through friction clutch to 18x11x14-in. right-angle compound air compressor; current gathered is three-phase, 60-cycle, 480 volts.—E.I.S., New York.

•

Silver-Ore Treatment: Leaching — Leaching Silver in Unroasted Tailings. G. L. Oldright. *Metal Industry,* Vol. 36, No. 10, March 7, 1930.

ARTICLE previously indexed from U. S. Bureau of Mines—Report of Investigation, No. 2981, Dec. 1929.—E.I.S., New York.

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Zinc Refining: Electrolytic — Refining Metals by Electrolysis. H. W. Hough. *Sci. Am.,* Vol. 142, No. 3, March, 1930.

DISCUSSION of production of refined zinc and copper by electrolytic process in Anaconda Copper Mining Company's plant near Great Falls, Mont.; brief description of plant operation.—E.I.S., New York.

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Mines and Mining: Stoping—Modified Mining Methods. *S. African Min. and Eng. Jl.,* Vol. 40, No. 2,000, Jan. 25, 1930.

SUGGESTIONS for modified shrinkage method in steeply inclined stopes; advantages are pointed out; editorial note states that contributor omitted to mention method proposed to prevent shrinkage pile advancing toward face.—E.I.S., New York.

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Mines and Mining: Welding Applications — Economy of Electric Arc Welding in Mine Plants. Keysselitz. *Elektrizitaet im Bergbau,* Vol. 4, No. 12, Dec. 14, 1929.

ADVANTAGES and disadvantages of various welding systems in mining practice; features of arc welding and its applicability and economy are discussed and exemplified. —E.I.S., New York.

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Zinc Metallurgy: Italy — Zinc Metallurgy in Italy. F. Sartori. *Metallurgia Italiana,* Vol. 22, No. 3, Jan. 1930.

DESCRIPTION of following Italian zinc smelters: Società di Monteponi, at Vado Ligure; Compagnia Imprese Elettriche Liguri, at San Dalmazza di Tenda; Stabilimento di Monteponi, in Sardinia; Società Mineraria e Metallurgica di Pertusola, at Crotone; operating methods and equipment.—E.I.S., New York.

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Magnesite Quarries and Quarrying: Washington—Aërial Tramway Transports Raw Material Five Miles to Plant of Northwest Magnesite Company. *Pit and Quarry,* Vol. 19, No. 12, 1930.

HISTORY of Northwestern Magnesite Company, Chewelah, Wash., largest producer of magnesite in United States; quarrying operations and use of aërial tramway provided with 100 buckets each of 1,200-lb. capacity, delivering 200 tons in 8 hours.—E.I.S., New York.

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Mines and Mining: Germany—Influence of Concentration Methods on German Mining Problems. Grumbrecht. *Min. Jl. (Lond.),* Vol. 148, Nos. 4,930, 4,931, 4,932 and 4,933, Feb. 15 and 22; March 1 and 8, 1930.

FEB. 15: General tendency toward cheapening production costs through mechanization, typification, standardization, rationalization and concentrated methods; application to bituminous coal mining. Feb. 22: Lignite mines; bucket excavators. March 1: Excavator on caterpillar tractor, for drainage trenches; conveyor bridge for overburden; drag line scrapers and other machines. March 8: Potash mining; metal mines.—E.I.S., New York.

•

Ore Treatment: Classification—Preparation of Ore for Ore-Dressing Tables. W. Luyken. *Glueckauf,* Vol. 66, No. 5, Feb. 1, 1930.

FOR WET dressing on smooth tables, preliminary stream classification is best; for riffled tables it is preferable to grade raw ore by sieving; stream classification is cheaper and under certain conditions its use may be more profitable, even with riffled tables; for treating coal on dry tables, certain degree of classification should be carried out; with pneumatic separators classification is dependent on economic value in relation to improvement in end product.—E.I.S., New York.

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Potash Mines and Mining: Germany—Underground Geological Structure of Celle District with Special Reference to Deposits of Salt, Petroleum, and Diatomaceous Earths. H. Werner. *Zeit. fuer das Berg-, Huetten und- Salinenwesen,* Vol. 77, No. 4, 1929.

DESCRIPTION of geological formations of district, mineral deposits and mines located in important potash district in Hanover.—E.I.S., New York.

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Manganese Mines and Mining: Russia—Manganese Ore Mining in Krivoy-Rog District. A. I. Steshenko. *Gorniy Journal,* Vol. 105, Nos. 6 and 7, June and July, 1929.

CRITICAL survey of mining practice in region near Nikopol, South Russia; cost data. (In Russian.)—E.I.S., New York.

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Lead-Zinc Deposits: Siberia—Core Drill Exploration of Lead-Zinc Deposits in Trans-Baikal Territory during 1926 and 1928. V. M. Kreuter and B. I. Vozdvizhensky. *Gorniy Journal,* Vol. 105, Nos. 6 and 7, June and July, 1929.

DETAILED data on performance of core drilling units using diamond or colomite bits in exploring section in upper Argun basin, southeast of Nerchinsk, Siberia. (In Russian.)—E.I.S., New York.

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Rhodium — Recent Research on Rhodium. *Metallurgist,* March, 1930.

IN RESEARCH PAPER No. 127, 1929, W. H. Swanger deals with development of technique for melting and mechanical treatment of rhodium; new determinations of number of physical constants of metal have been made on especially purified material; properties of rhodium-platinum alloys were investigated by F. E. Carter in 1928, who found that metals form series of solid solution alloys.—E.I.S., New York.

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Chemical Equipment: Pulverizers — Modern Milling and Pulverizing Methods. W. H. D. Sutherland. *Chem. Age,* Vol. 22, No. 560, March 22, 1930.

PAPER deals with method of reducing all kinds of materials to various degrees of fineness to suit individual requirements; also blending of (1) solids, (2) solids and liquids, (3) liquids, such as colors, dyes, paints, printing inks, dental and face creams, oils, pharmaceutical preparations, etc.; descriptive account given of Swing Hammer Pulveriser, the "Kek" Mill, and the "Circulator" Mill, and of purposes for which they were designed. Paper presented before Junior Instn. Engrs.—E.I.S., New York.

Gold Mines and Mining: *Australia* — Gold Mining in Western Australia. *Indus. Australian and Min. Standard,* Vol. 88, No. 2128, Jan. 30, 1930.

NOTES on increased development activity; interest shown in application of combination of flotation and roasting methods of gold-ore treatment at Wiluna and at Lake View & Star mines.—E.I.S., New York.

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Ore Treatment: Flotation—Ore Concentration in 1929. L. Barcena y Diaz. *Revista Mineria Metalurgica y de Ingenieria,* Vol. 81, No. 3201, Jan. 16, 1930.

INFLUENCE of flotation in zinc metallurgy; treatment of oxidized ores; data on flotation; discussion of flow sheets. (Concluded.)—E.I.S., New York.

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Lead Ore Treatment: Roasting—Roasting and Sintering of Lead Ore in a Rotary Furnace. N. C. Kyriacou. *Revue de Métallurgie,* Vol. 27, No. 1, Jan. 1930.

DISCUSSION of theory and development of rotary roasting furnace; details of Kyriacou system of rotary furnace.—E.I.S., New York.

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Feldspar Mines and Mining—Flint and Feldspar Plant Employs Pumping of Dry Solids. H. P. Margerum. *Chem. and Met. Eng.,* Vol. 37, No. 4, April, 1930.

MATERIALS-HANDLING methods and equipment used by Golding & Sons plant of Consolidated Feldspar Corp., Trenton.—E.I.S., New York.

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Clay: Moisture Content — A Quick Method of Determining the Water Content of Clays. C. L. Deeds. *Am. Ceramic Soc.—Jl.,* Vol. 13, No. 3, March, 1930.

WATER content of clay is determined by taking representative sample of material, weighing out 2 kg. of it and adding 4 kg. of water; sample is plunged quickly; 250-c.c. flask is filled with resulting slip and weighed; amount of dry clay is determined from relation.—E.I.S., New York.

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Coal Mines and Mining: Conveyors—Applications and Economy of Belt Conveyors in Bituminous Coal Mining. H. Folkerts and K. Bechtold. *Glueckauf,* Vol. 66, Nos. 3 and 4, Jan. 18 and 25, 1930.

ADVANTAGE of belt conveyors in coal mining are set forth and some useful applications are described.—E.I.S., New York.

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Pumps: Corrosion — The Pumping of Corrosive Liquors. R. H. Berriman. *Instn. of Engrs. of Australia—Jl.,* Vol. 2, No. 2, Feb. 1930.

REPORT on experience at Risdon Works of Electrolytic Zinc Company of Australasia, Ltd.; outline of typical pumps; average life of centrifugal-pump parts; handling denitrated acid and nitrous vitriol.—E.I.S., New York.

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Copper Ore Treatment: Canada:—Copper Concentration as Applied to Canadian Ores. W. B. Maxwell. *Can. Min. Jl.,* Vol. 51, No. 16, April 18, 1930.

DISCUSSION of Canadian copper ores, some of which are complex and most of which contain gold and silver; milling practice at Britannia plant, at Granby Consolidated Anyox and Allenby plants, and at Noranda concentrator in Quebec; reagent consumption and milling data are given; some cost data on Britannia. Paper read before Empire Min. and Met. Congress in South Africa.—E.I.S., New York.

New Publications

SOVIET ECONOMIC DEVELOPMENT AND AMERICAN BUSINESS. *By Saul B. Bron. New York. Horace Liveright. Pp. 147. Price $1.50.*

THIS book, written by a former chairman of the board of directors of the Amtorg Trading Corporation, gives the results of the first year (Oct. 1, 1928, to Sept. 30, 1929) of operation of the Five-Year Plan, by which the basic industries of the U.S.S.R.—coal, oil, steel, chemicals, non-ferrous metals, machinery—will be developed, to a great extent with American equipment and with the assistance of American engineers and business men, about 800 of whom traveled to Russia in 1929. A list of individuals and firms now cooperating with the Soviet in this program includes many of the largest industro-engineering organizations in the United States, as well as of many experienced engineers.

One major effect of the economic development by the Soviet has been an increase in the national income, which is now 28 per cent greater than it was in 1913. The output of power, mainly electrical, during the same period, has increased by 232.4 per cent. Other large increases are shown in the production of agricultural machinery (plus 185.8 per cent); oil (plus 47.3 per cent); coal (plus 40.5 per cent); cotton cloth (plus 8.2 per cent) and in the majority of other divisions. Of interest is the fact that England is the largest customer of Soviet oil, taking 725,000 tons—an 87 per cent increase over the previous year.

Imports were curtailed during the year 1928-29 because of the unfavorable trade balance incurred during the previous year, but exports reached a post-War record of $458,000,000, exceeding those for 1927-28 by 15 per cent.

The survey is frank in admitting the unsatisfactory outcome of the agricultural program, although the social and technical reorganization of the industry exceeded expectations. In the various industrial establishments one notes that improvements in output and cost of manufacture have been effected by the encouragement of competitive performance. A seven-hour labor day, a continuous five-day week with one day off for each worker, and other radical innovations have proved highly satisfactory. The number of workers has steadily increased. Wages, on the upgrade, are now much higher than they were before the War, with social insurance and other benefits that were not available in the days of pre-War Russia.

Mr. Bron's analysis is replete with statistical information of Soviet development, and with many details of the various concessions open and contracts closed for technical assistance. The book will prove interesting and informative, especially to those who are watching the progress of what is perhaps the most highly organized and closely co-ordinated large-scale industrial experiment in the history of the world. A. W. ALLEN

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MINING METHODS. *By Charles A. Mitke. New York: McGraw-Hill Book Company. Pp. 195. Price $3.*

THOSE who read Mr. Mitke's series of articles on mining methods which were published in *Engineering and Mining Journal* at intervals in 1927 and 1928, beginning in September of the former year, will recall his lucid and practical descriptions, something necessary where stoping is concerned, especially for those who have difficulty in thinking in three dimensions. They will welcome this little volume, in which the series is presented as a unit in compact form.

For the benefit of those who have not read the earlier articles it may be said that Mr. Mitke uses a much simpler and less terrifying classification of mining methods than most, if not all, of those previously proposed. He classifies these methods according to the natural behavior of the ground on extraction. The basic principle underlying all stoping methods, he says, is the character of the ground in its natural state and the resulting set of local conditions caused by extraction.

He divides underground methods, first, into supported stopes and caved stopes. Supported stopes are divided into two classes, open and filled. The open stopes fall into two subdivisions—those containing no pillars or other forms of support, and those that do contain pillars or other forms of support, but no filling. Each subdivision is further divided into three classes, this completing the classification of open stopes. Filled stopes he divides into square-set (subdivided in three classes), cut-and-fill (subdivided into two classes), and shrinkage with subsequent fill (having two subdivisions). Caving methods he divides into branch-raise caving (having several variations, including Michigan sublevel caving with branch raising); combined shrinkage and caving (two subdivisions); top-slicing, horizontal and incline; and other methods combined with caving, as sub-stoping and caving, and top-slicing and sublevel caving. This completes his classification. Open stopes, he states, are principally applicable to hard-rock mines; filled stopes to medium and soft ground of high grade; and caved stopes are mainly used in medium and soft ground of low value and large extent. There is no stope which does not come under one of the headings used, he asserts. On the whole, the book is well worth having, and because of its compact size should be handy for the wandering engineer. A. H. HUBBELL.

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MINERALOGY. *By Sir Henry A. Miers. Second Edition, revised by H. L. Bowman. New York: The Macmillan Company. Pp. 658. Price $8.50.*

FOR the practical purposes of the average mining student and engineer almost any mineralogy will do, and the more condensed it is the better. But specialization brings need for more detailed work, and those seeking deeper knowledge of the subject will find Miers useful as an introduction to scientific study. The first edition appeared in 1902, so for even such a branch of science as mineralogy a new edition is desirable. The reviser has followed the original plan and as far as possible the original text.

Part I deals with the properties of minerals. Crystallography is the principal topic, the first 210 pages being devoted to discussion of crystalline properties. General physical and chemical properties are then taken up, and the attention is directed to the relations between them and the chemical composition of the mineral. Theories of crystal structure and the investigation of it by means of X-rays are next considered. The first part concludes with two chapters on general mineral description and determination. Part II (in the same volume) gives descriptions of the more important mineral species classified according to their chemical nature, as, for instance, the elements, the haloids, the monosulphides, the disulphides, the dioxides, without reference to the metal represented.

A. H. HUBBELL.

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MINING YEAR BOOK. *By Walter E. Skinner. Published by the author, 15, Dowgate Hill, London, E. C. 4, England. Price in England, 20s. 9d.; abroad, 21s. 6d.*

The 1930 edition of Mr. Skinner's well-known book brings the latest information concerning 1,584 mining companies that are of interest to the London investor. Executive, technical, and financial information is given in some detail for all of the more important companies. Lists of directors, and of dormant companies, and statistical tables and a dictionary of mining terms, complete this 1,015-page volume. The increasing importance of the African coppers makes this work even more valuable than usual.

INDUSTRIAL PROGRESS

Meters Will Detect Inefficient Use of Compressed Air

WHETHER compressed air be regarded as power or as a commodity to be distributed to various working faces, in mining operations it is consumed in huge quantities in the aggregate. Yet it is often distributed with seemingly small concern as to waste that may be occurring along the line or at the drill. The quantity produced is readily estimated by multiplying displacement by strokes per minute or simply by considering the power input of the driving motor. But even exact information of this sort is no guarantee that the air is used efficiently. Leaks, waste from carelessness in blowing smoke, and other losses occurring during transmission may be greater than suspected. Some loss from these causes is expected by every superintendent. But unless he has taken trouble to measure them, he really does not know how great they are.

About five years ago the Crown Mines, on the Rand, undertook to determine just what its losses were in this respect. Assigning an engineer to the task, the company made an investigation in successive sections of the mine. Air delivered to the various stopes and headings in one section was carefully measured and checked against the work performed. After a test of sufficiently long duration had been made in this section the instruments were moved to another part of the mine and the test was repeated. According to report, the losses proved greater than the company had realized. The knowledge thus gained undoubtedly paid for the trouble of the test.

The idea of measuring its air might be expected to suggest itself more readily to a company on the Rand than elsewhere, in view of the well-established practice there of compressing air at a central plant and distributing it over long distances to the different companies of the district, a meter being used to measure the amount taken by each consumer. In the United States such practice is not followed, save in an isolated instance or so, such as the central plant of the Commerce Mining & Royalty Company, in Oklahoma. Desire for greater economy, however, may prove an incentive to some operators to try to ascertain how efficiently they use their air. Where large volumes are to be measured, apparatus such as is used for metering gas will do.

A reliable air meter for determining the efficiency of pneumatic tools should be regarded as a necessity at every plant. Such tools are subject to a relatively rapid rate of wear, consuming much more air after prolonged service than at the start. Unless repairs are made when needed, the tool will take increasing quantities of air until it ceases to function properly.

If the flow be small, as in operations where the air consumption of a single drill is to be determined or a branch line is to be tested, small air meters already on the market can be utilized. Two such meters of the indicating type have been produced for several years by the New Jersey Meter Company, of Plainfield, N. J. One is of 10- to 100-cu.ft. capacity, 1-in. openings, for drills and other air tools rated as taking not over 60 cu.ft. per minute when new. The other is larger, having 50 to 300 cu.ft. capacity, 2-in. openings, for larger drills and tools where the actual consumption is not over 300 cu.ft. per minute. Both of these meters indicate volume directly with a uniform scale on which 1 cu.ft. is represented by the same distance, whether working at high or low capacity. They do not integrate the air flow over a period of time, but permit the rate of flow to be observed under different conditions. They have only one moving element, which floats on air and is frictionless and non-wearing. In consequence, they will register the same after long use. The principle on which they operate is the well-known law that the volume of a definite compressed fluid or gas flowing under small constant head through multiple orifices of the same shape and size is directly proportional to the number of orifices exposed to the flow.

Reference to Fig. 1 will make the operation clear. The wall of the metering cylinder has eight rows of accurately reamed holes, each successive hole being spaced at an exact distance above the one preceding. The moving element consists of a weighted piston in the metering cylinder, a small piston in the oil dashpot cylinder, and a rod joining the two pistons and extending upward where it moves, without contact, inside the sight glass at the top of the meter.

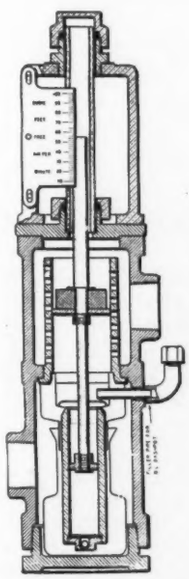


Fig. 1—A meter for determining air consumption of pneumatic tools. Its capacity ranges from 10 to 300 cu.ft.

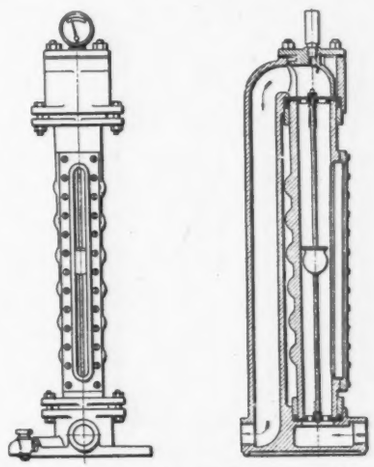


Fig. 2—An air meter of German make. It has a capacity of 100 to 350 cu.ft.

When air enters the inside of the metering cylinder it lifts the piston and uncovers some of the holes. A small head or difference of pressure is established by the weight of the moving element and the area of the piston on which this difference of pressure is established by the weight of the moving element and the area of the piston on which this difference of pressure acts. The moving element rises until the difference in pressure exactly balances the weight; pistons and rod are then floating in a position corresponding exactly to the volume of air flowing, the number of holes or partial holes exposed to the flow, and the height of the piston rod. The scale plate, mounted against the outside of the sight

A screen for testing large samples of coarse aggregate

glass, permits reading the position of the top end of the rod. Each meter is individually calibrated so that the readings on the scale plate correspond to those of a standardized instrument.

Another meter (Fig. 2) is described in the April *Demag News* (published by Demag at Duisburg, Germany). It consists of a tapered metal tube, wider at the top, having gaged graduations and a sight-glass. It may be interpolated, temporarily or permanently, in the air line to the tools.

Compressed air at constant pressure enters the metal tube through its inlet opening. The tube reposes on an annular rim of the housing, the joint between it and the housing being leak-proofed by means of a stuffing-box with a rubber ring. The air admitted forces an aluminum float upward on a metal rod, and the float eventually stops at some level which depends on the quantity of air flowing through. At this point, the graduated scale gives a direct indication, in cubic yards, or meters, per minute, of the volume of air with atmospheric pressure which corresponds to the quantity of compressed air passing through at the working pressure of 85 lb. per square inch. The accuracy of the readings is within 1 per cent. At the top, a spring stops the rising motion of the float. Having traversed the measuring tube, the compressed air returns to the inlet connection piece along a communication duct and thence, by flexible hose, reaches the tool tested.

The greater the quantity of air flowing through between the float and the sides of the tube—that is, the greater the velocity of the air referred to the unit of time—the higher it will rise.

This meter can be had for 4, 8, and 13 cu.yd. (3, 6, and 10 cu.m.) of air passing through per minute, referred to air atmospheric pressure. By means of a set of curves accompanying it, the volume per minute at any pressure deviating from 85 lb., for which the meter is built, may be determined.

Nickel Cast Iron Proves a Useful Alloy

FOR many purposes where castings are required, nickel cast iron can be used to good advantage, according to the International Nickel Company, the natural sponsors of this alloy. It is being applied effectively in the general-machinery, machine-tool, and power fields, as well as in the automotive and aëronautical industries. It has been used to secure a strong, readily machineable cast iron (Ni, 0.50 per cent); to increase the life of valve seats (Ni, 1.15 per cent), as well as of readily machineable light-weight cylinders (Ni, 1.25 per cent); to secure a close-grained, wear-resistant cylinder bore, without impairing machineability in the light-section flange (Ni, 0.75 per cent); and to increase density in heavy sections while maintaining machineability in the lighter sections of the same casting (Ni, 1.50 per cent). It has also been used in cast gears (Ni, 1.50 per cent) to secure a sturdy, close-grained material with adequate strength and wear resistance; in the beds of grinding machines (0.75 per cent) to eliminate scrap losses due to shrinkage and surface pitting and secure a dense material at the bottom of T-slots while maintaining satisfactory machineability in light sections; also in the beds of turret lathes (Ni, 0.60 per cent) to produce a close-grained, durable iron with adequate hardness in heavy sections, yet machineable throughout.

In the power field, nickel cast iron is being used in exhaust valve seats (Ni, 1.50 per cent) to secure a material having a high degree of wear resistance when employed at elevated temperatures; in Diesel-engine cylinder heads to insure machineability in light sections, and density, strength, and wear resistance throughout the casting (Ni, 0.75 per cent); in compressor steam cylinders (Ni, 1 per cent) to secure uniform density and a high degree of wear resistance in a heavy casting of varied sections; and in compressor stuffing boxes (Ni, 1 per cent) to insure grain refinement and freedom from internal shrinkage in a product that must be readily machineable. In each of the cases cited nickel cast iron is said to have solved the problems specified.

The Equipment Review

A Screen for Rapid Testing

For testing large samples of coarse aggregate accurately the so-called Weston testing screen, shown in an accompanying cut, has been developed. Tests made with it show it to be as accurate as the hand method. Two to three minutes are required to run a sample. The sieves may then be lifted on for inspection and weighing. Each size of aggregate being in a separate sieve, it can be inspected readily.

The machine is strongly built, with a base of welded steel plate and flanges for bolting to the floor. It has two castings of gray iron. These are the lower supporting casting and the upper cone-shaped one that revolves. The two are machine-fitted within each other to provide a tight seal for the worm-and-wheel drive. The worm shaft is provided with Timken bearings. It is driven by a ½-hp. motor and a V-belt.

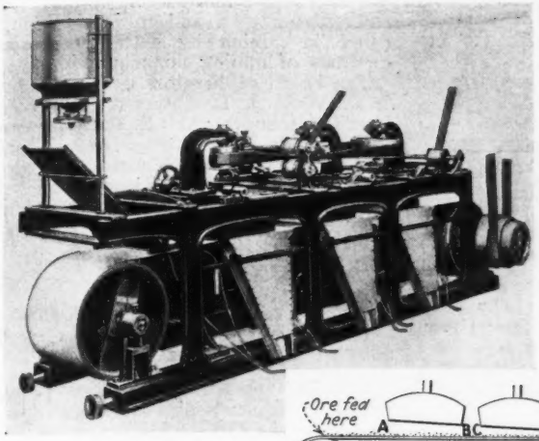
The screen selected as standard has four sieves. These are made of No. 18 gage steel with half-inch round steel hooks around the rim. They are 30 in. in diameter, with 4½-in. sides. Any combination of size openings may be had from ¼ in., round or square, up to very large sizes. The bottoms are cone-shaped. Fines that go through the bottom sieve pass through a hole in the cone-shaped casting and may be caught in a container.

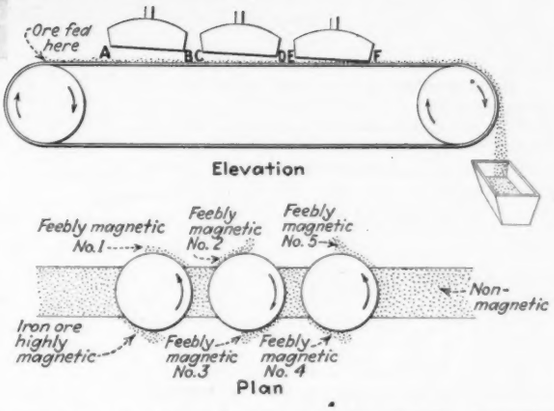
Each sieve weighs approximately 15 lb. when empty and will hold about 25 lb. of material, so that it can easily be handled by one man. The speed is approximately 13 r.p.m. Sieves may be had for either a.c. or d.c. current. They are made by the Hendrick Manufacturing Company, Carbondale, Pa.

For Separating Feebly Magnetic Ores

An electromagnetic separator introduced by the Rapid Magnetting Machine Company, Ltd., Lombard St., Birmingham, England, according to the manufacturer, will separate feebly magnetic ores successfully. These ores include those containing tungsten and tin, tungsten and bismuth, as well as monazite sand, and zinc blende.

The sketch on p. 523 (exaggerated to facilitate understanding) shows the separating disks above the belt. By setting the disks as shown, so that the distance or air gap between the ore and the edges (numbered 1, 2, 3, 4, 5, 6 in the sketch) is gradually diminished, the intensity of the magnetic zones is successively increased, No. 6 being the highest. It will therefore be readily understood, says the manufacturer, that where only one magnetic product, such as tungsten, is required, the cleanest and coarsest particles will be separated out first, the size gradually diminishing until the fine floury particles will be recovered at No. 6. No estimate as to capacity can be guaranteed until actual tests on the ore to be treated have been made. A tungsten-tin ore containing 21.86 per cent tungstic oxide and 62.09 per cent stannic acid was treated





Left, An electromagnetic separator for treating feebly magnetic ores. Below, A sketch indicating relation of magnets to belt conveyor.

on one of these machines. It yielded a tungsten product containing 71.27 per cent tungstic oxide and only 0.50 per cent stannic acid. The tin product contained 75.87 per cent stannic acid and only 0.30 per cent tungstic oxide. Other data showing similar excellent separation are furnished by the company.

Additional advantages claimed for this separator are that it reduces dust to a minimum and that it consumes less current than the cross-belt type of separator. The strength of each magnet pole is controllable by a rheostat. Each disk may be adjusted vertically by means of a hand wheel, not only as to height above the belt but also as to angle to the plane of the belt. Inasmuch as cross belts are dispensed with, the separating disks may be set closer to the ore, thus increasing the efficiency of operation, particularly as regards the fine floury ore.

Prefers Gable-Bottom Cars

Mine cars of the gable-bottom type have been selected by Mount Isa Mines, Ltd., Queensland, Australia. Sixty all-steel cars and 100 extra sets of wheels and axles were recently shipped by the El Paso Foundry & Machine Company, El Paso, Tex. The cars are of the gable type, 75 cu.ft. capacity, with alloy-steel axles, pressed-steel wheels, and Timken roller bearings. They are to be used with locomotives of English manufacture. Complete they weigh 4,575 lb. each. After fabrication they were assembled, painted, and inspected, after which they were partly disassembled for export crating. One is shown in the accompanying cut.

New Fine-Mesh Screens of Manganese Steel

For grading fine, abrasive materials the Manganese Steel Forge Company, Philadelphia, has developed a fine-mesh screen cloth made of its Rol-Man drawn manganese steel wire. The steel used is said to have eight to ten times the resistance to wear and 2½ times the toughness and strength of ordinary carbon steel, thus reducing maintenance. The new cloth is woven with a double-crimp mesh and gives a resilient screening surface. It may be had in sizes from 2 to 16 mesh, with square or rectangular openings and in desired wire diameters. It comes in rolls of 50 ft. and longer, and in widths of 24, 36, 48, and 52 in., as well as in special widths and lengths.

INDUSTRIAL NOTES

Cutler-Hammer, Inc., of Milwaukee, Wis., announces that it has purchased United Electric Manufacturing, also of Milwaukee.

Chain Belt Company, of Milwaukee, Wis., has moved its New York office to the new Chrysler Building, 405 Lexington Ave.

Elliott Company, of Jeannette, Pa., announces the removal of its New York offices to 225 Broadway.

Schlesische Aktiengesellschaft für Bergbau und Hüttenbetrieb, Kattowitz, Poland, have appointed Gesellschaft für Metalle, Erze und Hüttenerzeugnisse, Berlin, as their sales agent for Germany, excepting Silesia and Rhenish Westphalia, which territory they will cover themselves.

Thyle Machinery Company, of San Francisco, has assigned to The Dorr Company foreign rights for the Bradley density-control valve.

Southern Manganese Steel Company, effective May 1, is being operated as the Southern Manganese Steel division of American Manganese Steel Company.

E. D. Bullard Company is the name reassumed on April 1 by the former Bullard-Davis Company, of California.

Naylor Pipe Company, of Chicago, announces the removal of its New York office to the Chrysler Building, 405 Lexington Ave.

Hill Clutch Company, of Cleveland, Ohio, has opened a New York office, with A. L. Whiteside in charge.

Cleveland Rock Drill Company, of Cleveland, Ohio, has opened a new branch office in Prescott, Ariz., with C. O. LaTourette in charge as district manager.

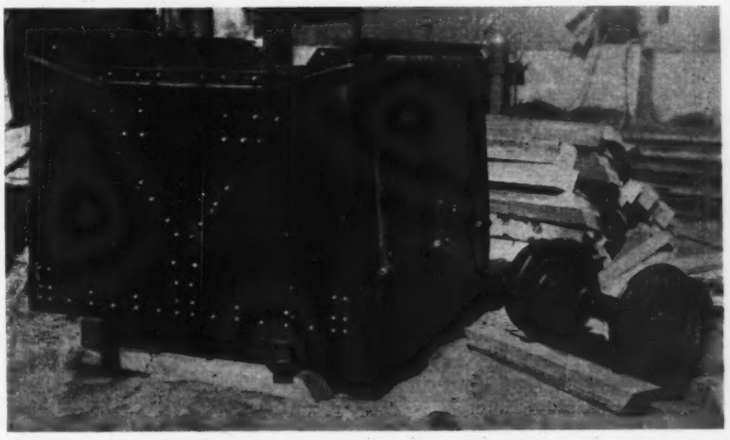
BULLETINS

Compensators—General Electric Company, Schenectady, N. Y. Bulletin GEA-570B, describing hand-starting compensators CR1034-K17, -K22 and -K37 dead-front cabinet type.

Resistors—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-1142A, which describes Type EW resistors, for mine and industrial-haulage locomotives.

Insulators—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Circular No. 1858, which describes outdoor apparatus insulators.

Welding—The Lincoln Electric Company, Cleveland, Ohio. Specification Bulletin No. S-1931A, describing "Stable-Arc" welder Model S-1931A, of the stationary platform type.



One of Mt. Isa's new cars, disassembled for crating

Personal Notes

George Otis Smith, director of the U. S. Geological Survey, was recently in San Francisco.

Rush M. Hess, of New York, will leave for Silverton, Colo., on May 26, for a month's examination work.

A. E. Treveathen arrived in Silverton, Colo., early in May, to supervise the reopening of the North Star mine.

Frederick Laist sailed from New York on the "Europa" on May 13, to visit the European plants of Anaconda Copper.

Charles A. Mitke sailed from San Francisco on the "Tahiti" on May 14, en route to Mount Isa, in Queensland, Australia.

B. B. Thayer, vice-president of Anaconda Copper, is on a tour of inspection of the company's Western properties.

F. E. Maulson has been appointed a director of Dome Mines, filling the vacancy created by the recent death of **Wallace Nesbitt.**

George P. Daniels, secretary of Barrows & Company, of New York, coal producers, has been elected a director of the Ardsley Butte Corporation.

W. L. Ziegler, of Hecla Mining, recently lectured before a group of students at the Montana State School of Mines, his subject being mill design.

Col. **E. J. Ristedt,** formerly on the staff of Santa Gertrudis, at Pachuca, Mexico, is now on duty in the office of the Chief of Engineers, Washington, D. C.

H. DeWitt Smith and **Henry Krumb** were elected directors of Calumet & Arizona at the recent annual meeting. They are both directors of Newmont Mining.

Scott Turner, director of the U. S. Bureau of Mines, delivered the graduating day address during the commencement exercises on May 16 at the Colorado School of Mines, Golden, Colo.

H. Foster Bain, Gustav Egloff, David B. Rushmore, and **Scott Turner** are the representatives of the A.I.M.E. at the forthcoming World Power Conference, to open in Berlin on June 16.

Albert Burch, mining engineer, of Medford, Ore., will be general chairman of a conference of mining men called for July 15 at Grants Pass, Ore., by the Northern California-Southern Oregon Development Association.

S. G. Blaylock, vice-president and general manager of Consolidated Mining & Smelting, who recently underwent two serious operations in Montreal, has returned to his home at Trail, B. C., where he is recuperating rapidly.

John B. Taylor, supervisor of the Deer Lodge National Forest, delivered an address before the Montana Society of Engineers at Butte on May 12. His topic was "Forests in Montana in Their Relation to the Mining Industry."

J. T. Pardee will head a party for the U. S. Geological Survey in southwestern Oregon this summer. The party will be divided into three crews, and will begin to work on about June 1. Headquarters will be at Grants Pass, Ore.

P. E. Peterson, of Vancouver, left New York for Turkestan early in May. He is under contract to the Soviet government for two years, and will have charge of silver-lead mining and milling operations in the mountain region of Turkestan.

W. H. Schacht, general manager of Copper Range, was elected president of the company at a directors' meeting following the recent annual stockholders' meeting. He succeeds **W. A. Paine,** who died recently. **Stephen Paine** was elected vice-president.

W. S. Robinson, managing director of the Zinc Corporation, and director of Electrolytic Zinc, North Broken Hill, and Imperial Smelting, all of Australia, is now on the "Aorangi," en route to Vancouver, after having spent eight months in Australia.

Harry S. Thayer, consulting engineer and geologist, formerly with Anaconda Copper, the McNeill-Penrose interests, and Lion Hill Amalgamated, in the Ophir district of Utah, has been appointed to the board of directors of the New York Mining Exchange.

J. A. Swanson sailed from New York on May 8, with Mrs. Swanson, for Bremen, Germany, en route to Russia, where he has accepted a position with the U.S.S.R. as mine superintendent at Uralmedstroy. Mr. Swanson was formerly with Granby Consolidated, at Anyox, B. C.

W. N. Ellis, metallurgist at the Murray plant of American Smelting & Refining, has resigned to accept a position as superintendent of the lead plant of Cerro de Pasco, at Oroya, Peru. He has been with A. S. & R. at the East Helena, Federal, and Murray plants for the last nine years. Mr. Ellis and his family sailed for Peru on May 22.

H. C. Smith, formerly general superintendent in charge of local operations of Granby Consolidated Mining, Smelting & Power at Allenby and Copper Mountain, B. C., has been appointed assistant general manager, with headquarters at Vancouver, B. C. **R. L. Healy,** formerly consulting engineer at Vancouver, succeeds Mr. Smith at Copper Mountain and Allenby. **J. A. McLaughlin,** formerly mine superintendent at Copper Mountain, has resigned to accept a position with the Soviet government in southern Russia, and has been succeeded by **V. G. Anderson.**

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New Mining Association in Colorado

A group of Colorado mining men, including former Governor Oliver H. Shoup, met on May 9 in Denver to form the Mine Owners and Operators' Association. Its chief purposes are stated to be the promotion of co-operation among operators, and to inspire confidence in mining by bettering present methods of mining financing.

The board of directors is composed of J. R. Wolf, J. L. Fawcett, and C. W. Lerchen, founders; and Samuel Bernard, C. W. Church, Richard Hughes, John Joyce, George Lewis, Thomas McGuire, J. T. Milliken, J. W. Nichols, William Roach, H. H. Russell, and former Governor Shoup.

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New Yorkers to Hear About Empire Congress Trip

E. E. Ellis, president of Universal Exploration, U. S. Steel subsidiary, who was a member of the Empire Mining and Metallurgical Congress that recently toured the mining districts of South Africa and Rhodesia, will relate his impressions of the trip before the New York section of the A.I.M.E. on Wednesday, May 28. Several reels of moving pictures which he took will be shown in connection with the talk. A dinner precedes the meeting, to be held in the rooms of the Building Trades Employers' Association, 2 Park Ave. All who are interested are invited, but reservations must be made in advance through L. F. Strobel, Room 5,002, 233 Broadway (phone Fitzroy 9668).

OBITUARY

Welch D. Mansfield, who was at one time connected with the El Paso mine, near Cripple Creek, Colo., and who had mining interests in Mexico, died in Los Angeles on May 2. Mr. Mansfield was 61 years of age.

Arthur K. Mitchell, until recently assistant to the president of St. Joseph Lead, died at his home in Bronxville, N. Y., on May 5. Although his headquarters were in New York, he frequently visited the company's mines in Missouri. In 1920 he invented the Mitchell underground shovel, which was adopted by St. Joseph and several other mining companies. Mr. Mitchell was 46 years old.

Arthur K. Knickerbocker, chief engineer for the Butler mining interests on the Mesabi and Cuyuna iron ranges, died at St. Luke's Hospital, St. Paul, Minn., on April 26. He was a graduate of the Minnesota School of Mines, class of 1908, and was formerly chief engineer of the Great Northern Iron Ore properties. He was the pioneer in the successful adaptation of jigs to the concentration of Minnesota ores. Mr. Knickerbocker was 43 years old, and is survived by his widow and one son.

Frank H. Taylor, mining engineer, and discoverer of the Topley-Richfield mine, died recently at Vancouver, B. C. He was born in Bournemouth, England, 44 years ago, and prospected in Nevada, California, and Montana before going to British Columbia, when he settled in the Omineca district. At the time of his death he was operating the Owen Lake mine, at Owen Lake, B. C. He was president of the Topley-Richfield and Owen Lake companies, and vice-president of the Omineca branch of the British Columbia Chamber of Mines, of which he was an active member.

NEWS OF THE INDUSTRY

Summary

St. Joseph Lead is building a new zinc smelter in the Pittsburgh district to treat concentrate from its mines in St. Lawrence County, N. Y. The plant is expected to be ready for operation this fall.

* * *

Arizona copper smelters may use natural gas from Texas and Oklahoma as fuel if a 500-mile piping project, planned by two engineering firms, goes through. Phelps Dodge may build new smelting works in Arizona to treat entire concentrate output of its own and Calumet & Arizona's mines, provided proposed merger is also completed.

* * *

Climax Molybdenum is building a new crushing plant at the mouth of the Phillipson tunnel, being driven to intersect the orebody at its property in Colorado 450 ft. below the upper workings. Completion of the tunnel is expected within a month.

* * *

American Smelting & Refining has closed its Matehuala copper smelter in San Luis Potosi, Mexico, because of water shortage. Other operations in the state are not expected to be affected.

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Operations have been started at the new Skelleftea copper smelter, in the Boliden district, Sweden. Ore treated carries considerable gold.

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An embargo to prevent all importations of silver save for metallurgical treatment and subsequent re-export has been proposed by Representative Arentz, of Nevada, as a possible substitute for the Pittman silver tariff.

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Reports that Bunker Hill & Sullivan, largest lead producer in the Coeur d'Alene district, had curtailed production are denied as untrue. Development of new orebody in Sullivan mine continues favorably.

Mount Isa Mill to Start in August; Reserves Now 28,000,000 Tons

MILLING of lead-zinc-silver ore at the Mount Isa Mines property, in western Queensland, Australia, will probably be started in August, when the first 500-ton section of the 2,000-ton plant will be put into operation. Smelting of lead concentrate will probably be started before the end of the year. Ore reserves have been further increased, according to a report by the technical committee for the period up to April 30, and are now estimated at 28,000,000 tons, with a gross value of £80,000,000 at current low metal prices. Nearly this entire tonnage is above the 750 level, and drilling is still in progress.

The limits of the three orebodies for which reserves have been estimated have not yet been reached either in length or depth. In addition, several other orebodies have been encountered. As at present known, the mineralized area is 2½ miles long and 1,500 ft. wide. The deepest drill hole on the Black Star lode, at a depth of 1,000 ft., has given results that check remarkably with those obtained on higher levels. At this point the total width is 200 ft., assaying 6.8 per cent lead, 5.6 per cent zinc, and 4.3 oz. of silver to the ton. The total length of the Black Star orebody proved to date is 2,400 ft., drill hole A11 having cut a total of 130 ft. of ore at a depth of 500 ft. at the southern end of the orebody. The average width of the Black Star orebody over the length of 2,400 ft. is 183 ft., or about 4,000,000 tons of ore per 100 ft. of depth.

All the drill holes that have penetrated the ore-bearing territory in the footwall of the Black Star orebody have cut through parallel veins of good width and have already proved 2,500,000 tons of high-grade ore. Underground crosscuts now being driven across the 1,500 ft. of territory between the Rio Grande, Black Rock, and other orebodies on the one side and the Black Star orebody on the other side are expected to cut additional parallel orebodies.

Some delay has been experienced in developing the mine because the flow of water encountered underground was larger than expected and also because floods on the government railroad have delayed delivery of coal and other materials. The Davidson shaft has been connected with the main ventilation shaft, 850 ft. north, and is now being connected with the man-and-supply shaft, which has been completed to the main haulage level. The main hoisting shaft is almost complete to this level, which will be 350 ft. deep. Ultimately, the mine will be equipped for a daily output of 10,000 tons of ore, and metallurgical plants are being built with a view to ultimate expansion to that figure.

L. D. Anderson, of U. S. Smelting, Refining & Mining, is visiting Mount Isa and reports that he is well satisfied with the progress made in plant construction. Milling will be started one section at a time, so as to break in the milling crews and make necessary adjustments. Even with the price of lead at its present level, and assuming no credit for zinc, estimated profits are £596,000 annually.

Drilling has already been started at the Silver King mine, on the Lawn Hills Concession of Mining Trust, which controls Mount Isa. Three diamond drills are now in operation at the property, which is in northern Queensland, under the direction of Roland Blanchard, geologist. Ore has been proved for a length of 600 ft. and a width of 60 ft. at the Silver King, but to a depth of only 200 ft.

■

Climax Building New Crushing Plant at Phillipson Tunnel

On April 25, the Climax Molybdenum Company started excavation work for a new crushing plant to be built this year at its properties in Lake County, Colo. It is being constructed about 400 ft. from the present mill and will be located so as to receive all ore coming from the new Phillipson tunnel, now being developed. The crushing plant is designed to reduce ore passing through 30-in. grizzlies to a mill feed of ⅜ in.

Ore from the Phillipson level will be dumped from 10-ton Granby-type side-dump cars into a reinforced cylindrical concrete ore bin of 500 tons' capacity. From this bin, the ore will be fed by a Ross feeder to a 60x48-in. all-steel Buchanan jaw crusher. From the jaw crusher the ore will be delivered to a 7-ft. Symons cone crusher by a fan conveyor 6 ft. wide. The product from the 7-ft. cone crusher will be conveyed to three Traylor vibrating screens and the minus-⅜-in. product from the screens will be discharged onto the conveyor belt carrying the finished product to the mill. Oversize from the screens will be returned to a 5½-ft. Symons cone crusher for final crushing. In addition, the present installation provides for another 5½-ft. Symons cone crusher, which the company plans to install later. The crusher building will be 40 ft. wide and 200 ft. long and the crushers will be served by a 15-ton Whiting crane.

The Phillipson tunnel, which was started about a year ago, has now been advanced 1,900 ft. through heavy ground, all of which required timbering, and the Mosquito Fault will, if expectations be realized, be crossed some time during the next thirty days. This new level is 450 ft. vertically below the upper workings and will develop an immense tonnage of molybdenum ore.

Operations at Climax are now being conducted on the basis of 35,000 tons of ore per month and are producing about 250,000 lb. of molybdenum per month.

St. Joe Building Zinc Plant in Pittsburgh District

ST. JOSEPH LEAD has completed plans for the erection of a zinc smelter near Monaca, Beaver County, Pa. A site of about two hundred acres on the left bank of the Ohio River has been purchased, and construction work will start immediately. This project will provide smelting facilities for the production of zinc concentrates from the company's Edwards and Balmat mines, in St. Lawrence County, N. Y. Concentrates are now being produced there at the rate of about 120 tons daily, and the capacity of the new smelting plant will be based on that tonnage. The electrothermic process to be installed, the result of experimental work carried out by the company's engineers at Herculaneum, Mo., is well adapted for the production of both slab zinc and zinc oxide. Both products will be produced at the new plant, as well as sulphuric acid from the roasters.

The Pittsburgh district was chosen as a location because of the availability of electric energy at that point and its proximity to markets. Construction work has been intrusted to the firm of United Engineers & Constructors, Inc., of Philadelphia. The plant is expected to be in operation late this year.

■

Arizona Smelters to Obtain Natural Gas From Texas

Although details have not yet been made public, piping of natural gas from oil fields in Texas and Oklahoma to the Arizona copper-mining districts for use as fuel in smelting operations seems fairly certain. Newspaper reports from Tucson, Ariz., state that the line—which will probably be more than 500 miles long—will be laid either to Douglas or to Globe and that it will be used principally for domestic and smelting needs.

Ford, Bacon & Davis and Sanderson & Porter are the engineering firms mentioned as interested in constructing the pipe line. Inquiry at the offices of the former company elicited the reply that no information is yet available for publication. Phelps Dodge confirmed reports that it might be interested in using natural gas. If the Calumet & Arizona-Phelps Dodge merger is consummated, the two companies may build one large smelter to treat their entire concentrate output with natural gas as fuel.

■

United American Cuts Ore

Crosscutting from the United American shaft, in the Oatman district of Arizona, has struck gold ore on the 1,000 level. A drift is now being driven west along the orebody and a connection will eventually be established with the drift on the same orebody from the 950 level of the adjoining Tom Reed property, thus providing better circulation of air. The faces of the two drifts are only about 125 ft. apart at present. Grade of ore at the United American is said to be about 1 oz. of gold per ton.

At the Tom Reed property, a crosscut is now being driven to the orebody on the 1,100 level. The management expects to cut ore about 550 ft. from the shaft. This point should be reached about the end of June, at the current rate of advance. About 35 tons of high-grade ore from the 950 level is being milled daily in the Tom Reed plant, and returns are sufficient to meet all current operating expenses.

■

Sheldon Curtailing Output at Mine and Smelter

Temporary curtailment of production at the Sheldon mine, near Walker, Ariz., and the Southwest Metals copper smelter, near Humboldt, will be undertaken in the latter half of this month because of the drop in the price of copper. The Southwest smelter, which is controlled by Sheldon Mining, was reopened in February after having been closed for several years. The company spent about $150,000 in remodeling the plant and cutting its capacity somewhat to permit more economical treatment.

Since starting, operations at the plant have been running smoothly, with production at the rate of more than 300,000 lb. of copper monthly. Ore has been shipped to the smelter from custom mines as well as the company's De Soto mine, and concentrate has been shipped from the Sheldon mill. About 125 tons of charge, in all, has been handled daily. The drop in the price of copper is expected to cut custom shipments, and the company therefore decided to reduce its entire scale of operation, although it expects that the reduction will be only temporary. At the mine, advantage will be taken of the curtailment to increase the amount of development work done. About half of the force of 125 men employed will be retained.

■

Arentz Proposes Silver Embargo as Substitute for Tariff

An embargo on silver, that would prevent all importations of that metal except for smelting or refining and subsequent re-export, has been proposed by Representative Samuel Arentz, of Nevada, as a possible substitute for a tariff of 30c. an ounce. Representative Arentz proposed his measure on May 9 after the House of Representatives had failed to confirm the Senate amendment calling for a silver tariff. In presenting his measure he urged that "something should be done to help the silver-mining situation in America." The exact wording of the proposed embargo follows:

"That from and after the passage of this act silver from any foreign country shall not be entitled to entry at any of the ports of the United States, and the importation thereof into the United States is hereby prohibited: *Provided, however,* That silver-bearing ores, mattes, base bullion, silver dross, reclaimed silver, scrap silver, and all alloys or combinations of silver imported into the United States for the purpose of processing, refining, or minting for export to a foreign country and not for use, sale, or disposition within the United States or any of its possessions, may be imported for such purpose upon the execution of a bond given in double the amount of the estimated value upon such silver contents so imported, conditioned that such silver contents will not be used, sold, or otherwise disposed of in the United States."

Make Annual Safety Awards to Mines and Quarries

OUTSTANDING safety achievements of several large mines and quarries have just been recognized in the awarding of the "Sentinels of Safety" trophy to the winners in the national safety competition, held under the auspices of the U. S. Bureau of Mines. About 300 mines and quarries, in 33 states, participated. Two iron mines in Michigan, two Tri-State zinc-lead mines, a salt mine in New York, a limestone mine in Ohio, and 46 quarries and open-cut mines were operated throughout 1929 without a single lost-time accident. The total amount of exposure to hazard was more than 106,000,000 man-hours.

Competing companies were grouped into five classes—namely, anthracite mines, bituminous coal mines, metal mines, non-metallic mineral mines, and quarry and open-cut mines. The winner in each group was the mine or quarry whose record showed the smallest loss of time from accidents in proportion to the total amount of time worked by all employees. Competition for the trophy was restricted to mines employing at least 50 men underground and to quarries and open-cut mines employing at least 25 men. The bronze trophy, "Sentinels of Safety," the work of a well-known artist, is awarded to the winning company in every group by *The Explosives Engineer.*

First place in the metal-mine group was given the Berkshire iron mine of Brule Mining, Stambaugh, Mich. This mine, which also won first place in this group in the 1928 contest, worked 345,695 man-hours with no lost-time accidents. In the metal-mine group, honorable mention was given the Homer iron-ore mine of Buffalo Iron Mining, Iron River, Mich.; the Wilbur zinc-lead mine of Commerce Mining & Royalty, Cherokee County, Kan.; the Jay Bird zinc-lead mine of Commerce Mining & Royalty, Miami, Okla., and the Webber zinc-lead mine of Commerce Mining & Royalty, Cherokee County, Kan. The first three named went through 1929 without incurring a single lost-time accident.

The best record among mines producing non-metallic minerals other than coal was made by the Retsof rock-salt mine of Retsof Mining, Retsof, N. Y. In this mine 257,927 man-hours were worked in 1929 with no lost-time accidents. In the non-metallic mine group honorable mention was given the Ironton limestone mine of Alpha Portland Cement, Ironton, Ohio; the North Holston gypsum mine of Beaver Products, North Holston, Va.; the Lower gypsum mine of United States Gypsum, Gypsum, Ohio; and the Akron gypsum mine of Certainteed Products, Akron, N. Y.

Among quarries and open-cut mines, the operation establishing the best record was the limestone quarry of Michigan Limestone & Chemical at Rogers City, Mich., which worked 753,156 man-hours without a lost-time accident.

■

Almaden Mines Curtail

Because of the restricted demand for quicksilver in Europe in 1929, the mining season at the Almaden mines, in Spain, has been curtailed, terminating in February, according to a report to the U. S. Department of Commerce. Most of last year's production is still unsold. The Almaden mines are the largest quicksilver producers in the world. Output in 1929 was estimated at 2,000 metric tons, or slightly less than 60,000 flasks.

Belmont Closes Property

Exploration and development at the Belmont Copper Mining property, near Superior, Ariz., has been stopped, pending results of work being done at the adjoining property of Magma Copper. A 1,650-ft. shaft has been sunk at the Belmont mine, and some silver-lead-gold ore has been developed. Further work would probably necessitate an additional shaft, however. Besides the Belmont, the company controls the Queen Creek and United Magma properties in the same district. Development in the south end of the Queen Creek property has yielded encouraging results.

Amulet to Continue Producing

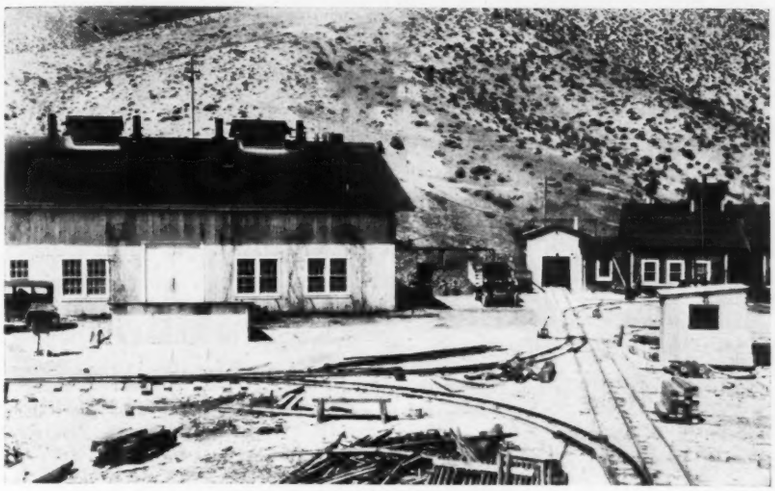
Treatment of ore in the new 300-ton mill of Amulet Mines, in the Rouyn district of Quebec, will be continued despite the drop in the price of copper. The plant started operations early in April and has been handling ore from the higher grade copper deposits in the mine. Only a small amount of zinc concentrate is being produced, and that is being stored until a better market is provided for it. Diamond drilling will be undertaken in several sections of the property during the summer in the hope of striking new orebodies such as the "F" orebody found last year.

Arrest Manganese Operator on Mail Fraud Charges

George P. Goodier, president of New Mexico Copper & Manganese, has been arrested in Denver, Colo., on a charge of conspiracy to use the mails to defraud in promoting the sales of his company's stock. A hearing on the case will take place at Jersey City, N. J., the headquarters of the brokerage firm that undertook the distribution of New Mexico Copper & Manganese stock.

New Mexico Copper & Manganese was incorporated in Colorado in January, 1929, to take over the assets of Boston Hill Manganese Mining, which consisted of several manganese properties near Silver City, N. M. Since 1923, the latter company had been shipping about 50,000 tons of manganese ore annually to Colorado Fuel & Iron. Mr. Goodier was operating the Boston Hill company and is understood to have made moderate profits. In 1929, however, the iron company discontinued its arrangement with Boston Hill. Without a market for the ore, Mr. Goodier decided to build a spiegeleisen furnace to enable shipments of the alloy to Eastern markets. To raise capital for this venture, the New Mexico Copper & Manganese Corporation was formed.

An agreement was made with Eastern brokers, whereby the mining company was to obtain 75c. per share for every share of stock sold by the brokers. A considerable quantity of the stock was sold through the mail by the brokers for as much as $4 a share, according to the government's charges. The accuracy of the quotations used in making these sales is questioned by officials. Wallace & Company, the principal brokerage firm involved, was indicted on the charge of using the mails to defraud and Mr. Goodier was included in the indictment.



Surface plant and portal of main Seven Troughs tunnel, near Lovelock, Nev.

High-Grade Ore Struck at Seven Troughs Gold

Raising from the 5,100 drift at the Seven Troughs Gold property, near Lovelock, Nev., has struck the highest grade ore yet encountered since the present company first undertook development in 1927, according to L. A. Friedman, general manager of the company. The strike was made in raise No. 9, and shows ore 18 in. wide. Twelve raises in all have been put up from the 5,100 drift, ready to begin stoping when the company's new cyanide plant is completed. Development is also being undertaken on the 7,800 drift. The drifts are designated by their distance from the portal of the main tunnel. Work on the new mill is completed with the exception of wiring and piping.

■

Granada Rouyn Completes Mill

Construction of the new milling plant of Granada Rouyn, a gold property in the Rouyn district of Quebec, is being completed and the plant is expected to start operating in the middle of June, unless unexpected delays occur in the delivery of power. Treatment of ore will be on the basis of 50 tons daily at the start, but eventually 200 tons will be handled daily. Granada Rouyn will be the second gold mine to enter production in the Rouyn district, Siscoe Gold having had its plant in operation for more than a year. Underground conditions in the Granada mine continue satisfactory. About 15,000 tons of ore has been hoisted and stockpiled on the surface. Stoping is under way on several levels.

New Orebody Cut at 6,500 Ft. on Champion Reef, in India

Development work on the No. 71 level of the Champion Reef Gold mine, in the Kolar field, Mysore, India, has shown an orebody 622 ft. long, according to A. T. J. Fraser, chairman of the board of directors. This orebody was first indicated on the No. 69 level, but it was neither as long nor of as good grade as it is at greater depth. For 2,000 ft. above the No. 69 level, which is at 6,500 ft., the Champion Reef vein had contained no ore, and the discovery of a new orebody at so great a depth is naturally considered most encouraging by the management. Two winzes have now been put down to the No. 72 level, and about 100 ft. of drifting has been done at that depth. The average grade is about 2 oz. of gold to the ton over an average width of 4.5 ft. The company's total ore reserves are estimated at 278,086 tons.

■

Copper Range Interested in New Michigan Power Firm

Copper District Power is the name of the new company that has been formed to take over the properties of the Northern Acquisition Company, on the Ontonagon River, in Ontonagon County, Mich., where a large hydro-electric power plant is being built to supply power to the Michigan copper district. Copper Range, together with the Middle West Utilities Company, will finance the new company. W. H. Schacht and F. W. Paine, of Copper Range, are among the directors of Copper District Power.

■

Taylor to Act as Consultant in X-Ray Study of Minerals

In connection with the studies of the U. S. Bureau of Mines and the Department of Mining and Metallurgical Research of the University of Utah on the physics of minerals, an X-ray laboratory has recently been established by the Bureau and the department. The work is in charge of J. Koster, who has until recently been associated with the X-ray laboratories of the Western Electric Company at Chicago.

Study of the X-ray in connection with mineral physics is a new field, and the Bureau and the department feel that they are fortunate in having secured, as consultant, Dr. Nelson W. Taylor, who at present holds a Guggenheim fellowship and is carrying on research work in the laboratory of Prof. V. M. Goldschmidt at Göttingen, Germany. Professor Goldschmidt's work of the last seven years has shed much light on the structure of crystals and on the geochemical distribution of the elements.

Recently, in connection with his work with Professor Goldschmidt, Dr. Taylor has been working with high-pressure equipment capable of use up to 1,000 atmospheres and 1,300 deg. C. By reason of his familiarity with the X-ray technique required with Debye-Sherrer cameras, Lane equipment, and the Moseley method of X-ray analysis, Dr. Taylor is expected to render very valuable services in connection with the Utah X-ray studies.

Lucky Tiger Continues Search for Ore as Reserves Shrink

Long crosscuts are being driven east and west from the known veins at the Tigre property of Lucky Tiger-Combination Gold, near Esqueda, Sonora, Mexico, in the hope of finding new deposits. Ore reserves on Dec. 31, 1929, had shrunk to 70,251 tons, assaying 0.06 oz. of gold and 33.4 oz. of silver to the ton, or little more than a year's supply at the present reduced milling rate. Development work has further confirmed the opinion that the main Gold Hill orebody has definitely terminated on the No. 13 level.

Some ore is now being developed below the No. 13 level, but it occurs in small marginal lenses. Exploration along the faulted segment of the vein below the No. 15 level has failed to develop ore. Favorable sites for future development still exist in the north faces of Nos. 5, 6, and 7 levels on the Seitz vein and Nos. 12, 13, 14, and 15 levels of the main vein. Work on these faces is now being pushed, in addition to the east-west crosscuts. This work was recommended by Guy N. Bjorge, geologist, who was engaged independently to examine the mine.

With the drop in the price of silver, substantial profits for the Tigre mine are impossible, according to R. T. Mishler, general manager of the company. By curtailing expenses the company hopes to be able to continue both operations and the development work proposed by Mr. Bjorge. About 150 tons of ore is handled daily. Average costs per ounce of silver produced in 1929, after crediting gold, were $0.419 an ounce, compared with $0.398 an ounce in 1928. Higher development and mining costs resulted in the increase, despite a reduction at the mill.

Steps have been taken by the company to secure government consent for suspension of operations at the Favor unit, in Jalisco, Mexico. Treatment costs at this property are high, because of the necessity of roasting ore prior to cyanidation, and a large loss is being sustained with the current low silver prices. Production in 1929 showed a considerable increase over 1928. Ore reserves were estimated at 109,591 metric tons, assaying 663 grams to the ton, but with 42c. silver, this material can no longer be classed as ore.

■

Start New Copper Smelter in Boliden District, Sweden

Operation of the new 200-ton copper smelter of Skelleftea Gruv Aktiebolag, at Ronnskar, Sweden, was started recently. The plant is treating ore from the Boliden field, discovered after deliberate search by the Swedish Geological Survey with modern electrical prospecting methods. Development work at the Boliden mine has been conducted since 1924, when it was discovered. High-grade ore from development work has been shipped to Germany and to Tacoma, Wash., for treatment.

Construction of the Ronnskar smelter, on the Gulf of Bothnia, about a mile from the Skelleftea harbor and 32 miles from the mine, is patterned on recent American models. The capacity, now 200 tons daily, will later be increased to 400 tons. A large brick chimney, 145 m. high (450 ft.), the tallest in Europe, and two Cottrell treaters handle the smelter gases. Power is supplied by two plants on the Skelleftea River, at Finnforsen and Krangforsen, which also supply the mine with power. Coal will be shipped from Germany and England. As the Gulf of Bothnia is frozen and closed to navigation half the year, a six months' supply will have to be maintained.

The ore treated averages 2.5 to 4 per cent copper, 25 to 30 per cent arsenic, 2 to 3 oz. gold, and 5 oz. of silver to the ton. Because of its high gold content, the field has been named the Klondyke of Sweden. Two new communities have been built for the employees, one at the waterfront near the smelter, and the other in the woods at the mine.

■

New headframe on No. 3 shaft at Lake Shore Mines, Kirkland Lake, Ont.

Ore at Basin Montana Shows Increase in Gold Content

Drifting east from the winze on the 600 level of the Grey Eagle mine of Basin Montana Tunnel, near Basin, Mont., has shown marked improvement in the gold content of the ore, which also carries silver, lead, and zinc. The east face of the drift is now 360 ft. from the winze. Drifting west of the winze has shown mill-grade ore containing copper pyrite and gray copper over a width of 15 ft. Samuel Barker, Jr., consulting engineer of the company, has estimated ore developed in the mine at about $1,200,000.

■

New Interests Buy Gold Mines at Thunder Mountain, Idaho

Purchase of the Sunnyside and Dewey gold mines, in the Thunder Mountain district, Idaho County, Idaho, by the American Gold Corporation has been announced. Considerable development work has been done on these properties, which were first worked in 1894, but they have been idle for the last twenty years or so. Equipment includes a forty-stamp mill and a cable tramway connecting the mines with the mill. At various times the properties have been owned by the Sunnyside Mining Company and the Barnsdall Corporation. Total production to date is not known.

Future of Tonopah Nicaragua Depends on Price of Copper

Development and equipment of the Tonopah Nicaragua property, in Nicaragua, Central America, is now largely contingent on the price of copper and the ability to finance the proposition, according to B. S. Bickmore, secretary of Tonopah Mining, which controls the property. The preliminary work at this property, consisting of a railroad survey from the mine to the coast, was completed in 1929. Efforts are being made to obtain from the Nicaraguan government authority to construct the railroad and also to obtain exemption from payment of an export duty on copper. A design and estimates of the cost of a smelter for treating the ores has been completed.

The Tonopah Nicaragua properties are known as the Santa Rita mines, in the Pis Pis district, 100 miles inland from Prinzapolca, on the Caribbean coast. Diamond drilling was completed in July, 1918. Proved ore reserves have been estimated at about 1,500,000 tons, averaging 5 per cent copper and 90c. in gold to the ton. About two-thirds of the proven tonnage is carbonate ore.

■

Bureau of Mines Preparing Non-Metallic Surveys

Papers on methods and costs at nonmetallic mining operations, on which a survey has been under way by the U. S. Bureau of Mines for the last three months, will be available within the next few weeks. The procedure followed in preparing these reports has been somewhat similar to the one used in the larger surveys of the coal and metal mines. Under the direction of J. R. Thoenen, the investigation, when completed, will have included more than 5,000 mines and pits. More than 500 questionnaires have returned to date. To show the type of operations that have been included, Mr. Thoenen states that about 100 clay mines have reported so far, approximately half underground and half open pit. An equal number of crushed-stone properties are listed and a slightly smaller number of sand and gravel pits. Salt, slate, and gypsum returns number about 40 each. Other mineral operations in the relative order of number include: baryrite, diatomite, feldspar, fluorspar, phosphate, asphalt, mica, pumice, emery and garnet.

The studies of mining methods and cost have reached a point where the Bureau is abstracting in condensed form the results from a number of papers. A general analysis of shrinkage methods in 33 mines will soon be ready for release.

■

Mining Trust Shaft Cuts Ore on Rhodesian Concession

A shaft at Chipalipata, Northern Rhodesia, has entered copper carbonate ore at a depth of 90 ft., according to the weekly progress report of Mining Trust. This shaft is being sunk in the western part of the company's North Charterland concession, which it holds until 1935. A cabled assay states that the ore assays 3 per cent copper and the width is not yet determined. At the surface, the width of the reef is 20 ft. Work is proceeding on eight other prospects in the concession.

Treadwell Yukon's camp at Wernecke, in the Mayo district

Consolidated M. & S. Options Area Adjoining Allenby

An option on the Voight group of claims, adjoining the Allenby unit of Granby Consolidated, at Copper Mountain, B. C., has been taken by Consolidated Mining & Smelting. Diamond drilling has been started on the property. Consolidated originally bonded the property two years ago, but dropped it after doing considerable drilling. Presumably the success of development work at Allenby, which is said to have increased ore reserves at depth, has encouraged further exploration for low-grade copper ore.

■

Eureka Lilly Opening New Lead Ore on 770 Level

Although low prices for metals, notably silver, have adversely affected profits at most of the properties of Chief Consolidated, in the Tintic district, Utah, general conditions at the Eureka Lilly mine of the company have been improved. New ore has been opened up on the 770, 850, and 900 levels. The new ore on the 770 level is a high-grade lead deposit. A considerable tonnage of ore is being mined above the 700 level.

Eureka Lilly, like the adjoining North Lily and Eureka Standard properties, is greatly increasing its output of gold ore. In the first quarter of 1930, total production of gold by Chief Consolidated was 6,424 oz., compared with 1,031 oz. in the first quarter of 1929 and 11,715 oz. for the entire year. Of the total company production in the first quarter of 1930, 5,516 oz. was produced by the Eureka Lilly mine.

■

Work Suspended at Toric

Development of the Toric mine, in the Alice Arm district of British Columbia, has been suspended by Britannia Mining & Smelting, Howe Sound subsidiary. No official statement has been made of the reason for the suspension, but local reports attribute it to a shortage of fuel oil which could not economically be replenished until the railroad is free from snow, which usually is not before the middle of June. Although a large body of silver-bearing material has been proved at the property, the decline in the price of silver may make profitable treatment impossible.

Reeves-McDonald Balks at Pend Oreille Power Plan

Declaring that zinc-lead orebodies adjacent to the Pend Oreille River in British Columbia could not be developed economically with purchased power, D. N. Hossle, counsel for Reeves-McDonald Mining, has notified the provincial water board that plans to open up the property will be abandoned unless the mining company is accorded water-power rights on the Pend Oreille River. The government proposal that West Kootenay Power be allowed to develop the full capacity of the Pend Oreille and required to sell power to Reeves-McDonald at the price now charged Consolidated Mining & Smelting, of which West Kootenay is a subsidiary, was flatly rejected.

Reeves-McDonald has offered to waive any claims against the West Kootenay for possible damage to its own development from flooding by a dam located at Seven Mile. Should such flooding appear possible, power would be supplied from the company's project in compensation for cutting down the height of the dam. The new situation developed at a hearing of an application by West Kootenay for a dam 150 ft. high at Cedar Creek, which Reeves-McDonald protested as a step to "freeze" it out of the river. The board reserved decision on the application.

■

Examines New Poorman Finds

Irving M. Reed, assistant territorial mining engineer for Alaska, has made a reconnoissance of the Poorman district, near Ruby, in which a gold strike was made two or three months ago. He reports that the region is being well prospected and predicts additional discoveries. Throughout Alaska, however, seasoned prospectors are regarding the strike with skepticism. Reports published in newspapers in the United States have given the impression that the strike was a big one and that a stampede to the district resulted. Actually, the prospectors gathered slowly, the population of the district being only 80 men a month and a half after the strike was made, as compared with about 40 previously. With the coming of spring, however, a larger number are likely to enter the field.

Bunker Hill Not Curtailing Because of Low Prices

Reports that Bunker Hill & Sullivan, operating silver-lead mines in the Coeur d'Alene district of Idaho, was curtailing its output because of the fall in metal prices are not true. Inquiry at the offices of the company on May 15 revealed that the plants are still operating at capacity. The rumors evidently originated when the Tybo unit of Treadwell Yukon, which is associated with Bunker Hill & Sullivan, was put on a one-shift basis early in May. They were repeated on the floor of the U. S. Senate by Senator Pittman, of Nevada, on May 8 in discussing the silver tariff.

For the three months ended March 31, 1930, Bunker Hill & Sullivan made a profit of $672,787 before depreciation and depletion. Production is about 37,500 tons of ore monthly. Development work on the new orebody in the Sullivan mine section is being continued. Stewart Campbell, state mine inspector of Idaho, recently inspected the new discovery and stated that he believed it would prove to be the most important ore discovery made in the Coeur d'Alene district in the last ten years. It averages 15 ft. wide and has been proved for a length of 440 ft. to date. It has been proved for a depth of 300 ft. Crosscuts are now being driven on the Kellogg tunnel and No. 17 levels, which, if they find ore, will add 1,950 ft. to its depth. The ore is of a high milling grade, containing no zinc.

■

New Company Formed to Work Revenue Mine in Montana

Butte Revenue Mines has been incorporated by W. B. Carroll, R. Lewis Brown, and Thomas L. Tutty, all of Butte, to operate the Revenue mine, near Norris, Mont. The property was formerly worked by Revenue Mines, Inc., and is said to have produced more than $2,500,000 in gold to a depth of 200 ft. It is equipped with mining machinery. Mr. Carroll was formerly a professor at the Montana State School of Mines.

■

Start Granada Lead Tunnel

Driving of a new tunnel at the property of Granada Lead, adjoining Golconda Lead, east of Wallace, Idaho, in the Coeur d'Alene district, was started early in May. Three shifts are being employed in driving the tunnel, which has as its objective the Golconda vein. Officials of the company, which is controlled by the same interests as Golconda, expect to cut it at a point about 1,900 ft. from the portal. They expect to cut the Granada vein 450 ft. from the portal.

■

Plan to Reopen May Lundy

Efforts will be made to reopen the May Lundy property, in Mono County, Calif. The Consolidated Stock & Bond Corporation, of San Francisco, is reported to have acquired the holdings, which have been dormant for several years. Recently the property was examined by a mining engineer and the feasibility of reopening it was considered. It is at an altitude of 10,000 to 11,000 ft.

Engineering Council Backs Legislation on Employment and Power Situations

ACTION which placed the engineering profession on record with respect to legislation now pending in Congress, and formulation of plans to enlist the co-operation of professional groups in projects of wide public interest, were approved by the administrative board of the American Engineering Council at its spring meeting at the Mayflower Hotel, Washington, on May 12 and 13.

The Wagner Prosperity Reserve bill, the Power bill, measures sponsored by Senator McNary and Representative Haugen for federal aid to engineering experiment stations, and a bill by Senator Brookhart to safeguard the classification of civilian employees in government employ, were among the legislative proposals approved by the board. President Carl E. Grunsky, of San Francisco, presided at the sessions, which had a full attendance of officers and representatives.

Legislation affecting members of the engineering profession engaged the close study of the board, including the Brookhart bill and one introduced by Representative Welch, of California, to extend to the present Personnel Classification Board absolute control of the specific salary as well as grade and salary range of every position within the scope of the Classification Act, without any curb or review. In the opinion of the Council's committee on public affairs, this measure would abolish administrative authority in the matter of promotions based on efficiency, and the board voted to oppose all attempts toward its substitution for the Brookhart bill.

Main features of a bill offered by Representative Griffin, of New York, to provide a medal of honor and awards to government employees for distinguished work in science met the enthusiastic approval of the board. The medals, carrying small annuities, would be awarded to employees recommended to the President by a commission consisting of one representative each of the National Academy of Sciences, the American Association for the Advancement of Science, and the American Engineering Council. In giving this approval, the Board suggested that no more than two medals be granted annually, and that these be so designated that they would invite no confusion with other honor awards conferred by the government.

Among other measures which the board considered were:

Formation of a committee to cooperate with the Bureau of Aeronautics of the Department of Commerce in conducting research and providing information for the guidance of the public and the profession in all matters relating to commercial aviation.

Appointment of a committee to make recommendations regarding bills introduced by Senator McNary, of Oregon, and Representative Parker, of New York, providing for the establishment of American air transport services overseas and to encourage construction in this country of aircraft for use in foreign commerce.

Opposition to bills introduced by Senator Connally and Representative Buchanan, both of Texas, providing for the establishment in the Department of the Interior of a National Reclamation Service to aid states and their political subdivisions in constructing improvements for flood prevention, drainage and irrigation.

Opposition to the bill sponsored by Senator Dill, of Washington, relating to suits for infringement of patents.

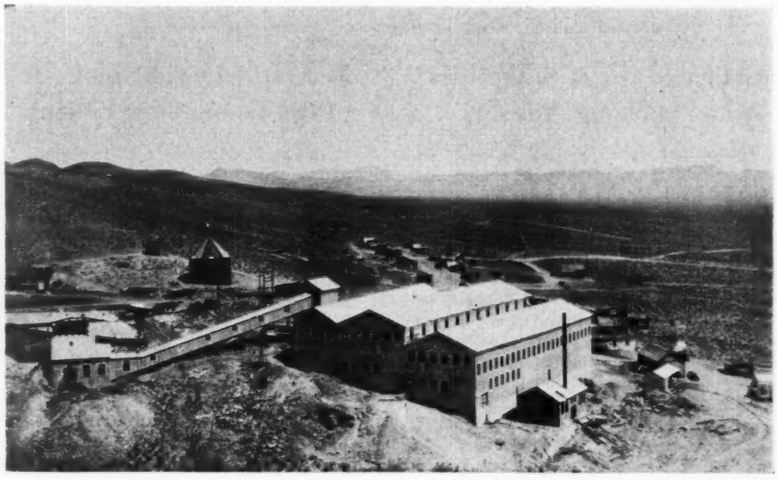
Formulation of definite plans for a single Court of Patent Appeals and steps to secure the co-operation of other organizations upon these plans.

Mr. Grunsky was guest of honor at a dinner given on the night of the opening session by the Washington Society of Engineers at the Chevy Chase Club.

Mohawk Cutting Tonnage

Mohawk Mining has cut the daily shipments of copper ore to its mill in the Michigan copper district from 1,800 to 1,500 tons. About a year ago, when it was producing from three shafts, daily shipments were 2,000 tons. The drop in the price of copper, combined with the limited amount of ground available in No. 1 shaft, is the cause for the drop in production. Costs are not expected to be affected adversely, as No. 6 shaft, which is now producing most of the tonnage, is comparatively high grade.

In sinking "E" shaft, on the Butler lode, at its Michigan mine, in Ontonagon County, Mohawk has encountered considerable faulting that has necessitated timbering and has resulted in slowing up the work.



New Seven Troughs cyanide plant, at Lovelock, Nev.

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A. S. & R. Closes Smelter at Matehuala, San Luis Potosi

Operations have been completely suspended at the 1,000-ton Matehuala copper smelter of American Smelting & Refining, in Mexico, because of water shortage caused by three years of almost continuous drought. The plant has been treating copper ore from the company's open-cut Dolores mine, at Matehuala, and silver ore from the Mexican-owned Santa Maria de la Paz property. Reports that both of these mines would close have been denied by A. S. & R. officials.

Water shortage has not yet affected the operations at the company's other properties in the state, which include a smelter at the city of San Luis Potosi and the mines that supply it. Officials have stated that this unit probably will not have to close.

■

Seneca Opening No. 11 Level

Development work on the No. 11 level of No. 1 shaft on the Seneca Copper property, in the Michigan copper district, has yielded better results than have been obtained on the Nos. 9 and 10 levels. The management has been considerably encouraged by this work, as the Ahmeek shoot, mined in adjoining Calumet & Hecla ground, is expected to be encountered below the present bottom of No. 1 shaft. Ore has been opened both north and south of the No. 2 shaft on the Nos. 19 and 20 levels. The test stopes on the Nos. 17 and 18 levels, north of the shaft, are producing a good grade of ore. Despite the drop in the price of copper, production is still about 1,000 tons daily.

■

Trimountain Property Closed

Operations have been suspended at the Trimountain mine of Copper Range, near Painesdale, Mich., because of the drop in the price of copper and the unfavorable development results obtained at depth. In 1929, the mine produced 1,408,689 lb. of copper at an average cost of 22.9c. a pound. The property has never been an important source of revenue to the company, the excess of receipts over expenditures from operating this property up to the end of 1919 being $3,000,000. Since then it has operated at a loss.

Diamond drilling of the property at depth, originally to be carried out from the bottom of the Trimountain property, will be done from the Champion workings. Should favorable ground be indicated, it will be mined through the Champion. The drilling program at the Baltic mine, also owned by Copper Range, will be continued as planned.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

German Manufacturers Protest Rationing of Copper Sales

Berlin, May 14.—German manufacturers of copper products yesterday sent a cable to New York City, protesting against the policy of rationing copper sales to Germany at Brussels. They declare that the Copper Exporters, Inc., desires to squeeze the market once again. The Exporters' organization, on the other hand, maintains that rationing of sales is necessary to prevent speculation. Germany has been allotted a quota of 4,000 tons of copper daily, which is termed entirely insufficient by the manufacturers, who desire to build up stocks of the metal now that copper is cheap. They say that if the present policy is continued, the situation in the spring of 1929 will be repeated, with disastrous results to all concerned.

. . . . Union Minière du Haut-Katanga has acquired an important interest in Hirsch Kupfer und Messingwerke, thus becoming a partner with Imperial Chemical Industries, Ltd., which has a 25 per cent interest in the company. The brass works of the company is considered the most up-to-date plant of its kind in Europe.

. . . . German zinc producers, in urging a new duty on imports of the metal, point out that the country could, if necessary, be entirely self-supporting. At the end of the War, Germany lost several of its zinc plants to Poland, thus occasioning a change in its status from zinc exporter to zinc importer. The producers feel that, without the handicap of the present low prices and cartel agreements to curtail output, Germany's requirements could now be filled from its own ores.

■

Witpoort to Push Development of Its Area on Far East Rand

Johannesburg, May 14. — Sir George Albu, chairman of Witpoort Gold Areas, made an extremely optimistic statement at the annual meeting of the company here. He states that the company is now in a position to push ahead development on a large scale, with every anticipation that results will prove the existence of another large, paying gold mine on the Far East Rand. The company possesses rights on 5,905 acres, adjoining the Brakpan and New Kleinfontein mines. It was first formed in 1895 as Rand Collieries, Ltd., as a coal-mining concern, but prospecting by boreholes indicated that the Main Reef series underlay the coal measures. Two shafts were put down in 1908 and 1910, respectively, and development up to 1913 showed 374,200 tons of ore averaging 5.3 dwt. per ton. All operations were suspended in that year and were not resumed until 1928, when the capitalization was reorganized and additional mining rights were obtained from the government. No. 1 shaft, 2,790 ft. deep, has been unwatered, and development is now in progress. At least two other new gold mines are being developed in the Far East Rand section—the East Geduld and the Daggafontein—and one other, the Grootvlei, may be worked.

. . . . Satisfactory statements were presented at the annual meetings of the other companies in the General Mining & Finance group, which controls Witpoort Gold, and the Union Corporation group. At the meeting of East Geduld, controlled by the latter, announcement was made that subscriptions have been received for 96 per cent of the new shares being issued to finance equipment of the property on the basis of treating 60,000 tons of ore monthly.

. . . . West End Diamonds, a company in the Bailey group, has closed down its mine at Postmasburg, west of Kimberley, Cape Province. The prevailing low price of diamonds and the unsettled condition of the market necessitated suspension. In the year ended June 30, 1929, the company produced 30,160 carats, valued at £91,305. Profit was £31,845. The company is capitalized at only £100,000.

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Broken Hill Companies Unite in Zinc Contract

Melbourne, Australia, May 10.—Official announcement has been made that after the expiration, on June 3, of the current Board of Trade contracts, by which zinc concentrate produced at Broken Hill is sold at very favorable terms, three of the leading Broken Hill lead-zinc producers will market zinc concentrate under a new agreement. North Broken Hill, Broken Hill South, and Zinc Corporation are the companies involved. At present these companies obtain aid from the Board of Trade whenever the price of zinc falls below £30 a ton on the London market. Under this agreement, a total of about £5,800,000 has been paid to the mining companies in excess over market prices since the inception of the agreement, which was formulated during the War to insure a supply of zinc to the British government.

. . . . Under the new agreement, the Electrolytic Zinc Company of Australasia, which operates a plant at Risdon, Tasmania, will purchase concentrate from the three Broken Hill companies. Any excess above its requirements will be bought by the Imperial Smelting Corporation, organized in 1929 to control mining and smelting companies in the British Empire, including the National Smelting Company, which operates smelting plants in South Wales. This agreement will insure a market for the mining companies when sale on the Continent to German or Belgian smelters would be profitless. It also maintains a supply of zinc concentrate for the British Empire, one of the principal objects of the Board of Trade contracts.

Rhodesia Broken Hill Making Profit Despite Low Zinc

London, May 16.—Rhodesia Broken Hill Development is producing electrolytic zinc at its plant in Northern Rhodesia at a cost of about £12 per long ton and is marketing it profitably in Europe at the present low prices of the metal—about £16 10s. to £17 on the London market. Operation of the plant at its full capacity of 50 tons of zinc daily is responsible for the low costs achieved, about 2.6c. a pound. A vanadium plant with an annual output of about 400 tons is being constructed at the property and will be completed in about a year. In addition to its oxidized zinc ore, which carries about 0.9 per cent vanadium oxide, and the slag dump, assaying about 1.2 per cent vanadium, the company has 38,000 tons of material classed as vanadium ore available for treatment in the new unit. It contains 8 per cent lead, 8 per cent zinc, and 3.5 per cent vanadium oxide.

. . . . Completion of three new drill holes has tended to corroborate existing theories of the northwest trend of the high-grade orebody discovered in the western section of the N'Changa property and extending into the R.C.B.C. ground. Estimates already published have put the ore reserves contained in the R.C.B.C. area alone at about 35,000,000 tons of 9 per cent copper. Hole B39, drilled on N'Changa ground, about 2,000 ft. southeast of NE5 (one of the best R.C.B.C. holes), showed 12 ft. of ore, averaging 9.5 per cent copper, at a depth of 451 ft. About one-quarter of this copper is sulphide. No. B39, incidentally, is about midway between Nos. B12 and BC1 on a northeast-southwest line. These two holes showed more than 150 ft. of ore averaging 3 per cent copper. In R.C.B.C. territory, No. NE22, put down to confirm the result obtained in NE1, which was blank, also failed to cut ore. This hole is apparently just south of the southern boundary of the high-grade orebody. NE10, drilled in the northwest corner of the orebody, has cut 37 ft. of 5.3 per cent copper, also largely oxide. It extends the northern boundary of the orebody about 1,200 ft. to the west. In the Chingola section of the R.C.B.C. holdings, about 2 miles west of the high-grade orebody, No. NE33 has been completed and shows 60 ft. of ore, averaging 7.18 per cent copper, largely oxide.

. . . . Drilling results at Mufulira continue to please Rhodesian Selection Trust, the controlling factor in the enterprise. In the meanwhile, plant construction is progressing and the company hopes to be in production by 1933 on the basis of 2,000,000 tons of ore annually. Rhodesian Selection, now that it has floated off Mufulira as a separate company, is centering its drilling activities at Chambishi, Luansobe, and Baluba, adjoining the Roan Antelope mine. Surface work is being done on other areas granted under the company's concession, which expired this year.

MARKET AND FINANCIAL NEWS

Stocks of Refined Copper Up on Small Shipments

Stocks of refined copper in the hands of North and South American producers on April 30 totaled 301,338 tons, a gain of 45,318 tons compared with the figures for the preceding month. Stocks of blister increased 2,114 tons. Stocks of copper in Great Britain and Havre were up 3,011 tons. Total stocks of copper above ground, according to the American Bureau of Metal Statistics, increased during the month of April to the extent of 50,443 tons.

Domestic shipments in April were poor, amounting to 50,017 tons, against 73,664 tons in March, and 99,051 tons in April, 1929. Export shipments totaled 29,196 tons, against 30,523 tons in March, and 57,708 tons in April a year ago.

United States mine production was at a slightly higher rate during April. The daily rate was 2,011 tons, against 1,975 tons in March, and 3,163 tons in April, 1929.

Refined copper production, shipments and stocks, North and South America, in tons, follow:

Production:	February, 1930	March, 1930	April, 1930
Primary	109,826	114,899	113,758
Scrap	11,369	12,165	10,773
Total	121,195	127,064	124,531
Daily rate	4,328	4,099	4,151
Shipments:			
Exports	29,597	30,523	29,196
Domestic	61,879	73,644	50,017
Total	91,476	104,167	79,213
Stock end of month	233,123	256,020	301,338

Production and stocks:

Production:	March, 1930	April, 1930
U. S. mines	61,216	60,338
Blister, No. America	91,780	88,787
Blister, So. America	21,367	21,037
Refined, No. and So. Am.	127,064	124,531
World, blister basis	147,305	.....
Stocks:		
No. and So. America:		
Blister and in process	266,561	268,675
Refined	256,020	301,338
Total	522,581	570,013
Great Britain, total	7,918	9,458
Havre	6,213	7,684

Distribution of United States copper production in February and March:

	March, 1930	April, 1930
Porphyry mines	22,839	22,337
Lake mines	6,533	7,357
Vein mines	25,519	24,944
Custom ores	6,325	(a)5,700
Total crude production	61,216	60,338
Daily rate	1,975	2,011
Imports in ore and matte	6,911	.....
Blister from scrap	6,742	.....
Smelter production	78,514	.....

(a) Partly estimated.

United States Lead Output

The American Bureau of Metal Statistics has revised its method of reporting production of lead in the United States. The new method includes production of secondary lead that is refined by the same processes that are used for the refining of virgin lead. Statistics covering the first three months of the current year, in short tons, follow:

	Jan.	Feb.	March
Production:			
From domestic ore (a)	49,991	54,125	56,552
Secondary and foreign	9,327	6,226	8,600
Total	59,318	60,351	65,152
Stock at beginning	51,076	47,756	43,077
Total supply	110,394	108,107	108,229
Stock at end	47,756	43,077	42,469
Shipments by difference	62,638	65,030	65,760
Shipments reported	63,954	64,249	65,051

(a) Includes small proportion of secondary lead that it is impracticable to separate statistically.

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Mining Corporation of Canada

Operating profit at the properties of Mining Corporation of Canada, at Cobalt, Ont., decreased from $153,078 in 1928 to $85,819 in 1929. After including profits on investments, and extraordinary charges, the company showed a net profit of $478,497, compared with $494,975 in 1928. The company's investments increased from $2,683,015 (at or below market value) at the end of 1928 to $3,573,076 at the end of 1929. As a result, the company was able to write the value of its mining rights down $129,786, and they are now put at $3,650,000. Total assets are put at $8,619,399, compared with $8,452,078.

April Zinc Business and Average Prices

Sales of slab zinc by twelve companies reporting to the American Zinc Institute during April totaled 17,677 tons, of which 8,313 tons were for April delivery and the remainder for subsequent delivery. The weighted average price paid for Prime Western zinc for April delivery was 4.875c., and for Brass Special 4.966c. On forward business the weighted average selling price on Prime Western was 4.912c., and on Brass Special, 4.968c.

April zinc statistics, compiled by the American Zinc Institute, follow:

Stock April 1	94,033
Produced	43,080
Shipped	40,660
Stock April 30	96,453
Shipped for export	26
Sold but not delivered April 30	29,003
(a) Average number of retorts operating during month	49,373
(a) Retorts operating April 30	49,150

(a) Retort capacity relates only to Prime Western and a small quantity of Brass Special and High-Grade zinc production.

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Quicksilver Output Curtailed

Owing to the restricted demand for quicksilver in Europe during 1929, the mining season in the Almaden mines in Spain has been curtailed, terminating in February, according to a report to the Department of Commerce. The greater part of last season's output has been warehoused, pending a broader market for the product. Spanish production in 1929 is estimated at 2,000 metric tons.

To Users of *E. & M. J.* Market Prices and Data

THE semi-monthly *Engineering and Mining Journal* (which you are now reading) carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, and minerals who require the latest information every week, we now publish every Wednesday night a weekly—*Metal and Mineral Markets*. Printed at high speed, and in a new compact form for reference use, this new service has received enthusiastic indorsement from readers not requiring the technical contents and field operating news carried in the magazine. *Metal and Mineral Markets* is priced to subscribers in the United States and possessions at $2 yearly; to countries in the Americas, but outside the United States, $5; elsewhere, $10 per annum.

Freight Rate Hearing at Phoenix and Salt Lake

Hearings on freight rates for nonferrous metals were held by the Interstate Commerce Commission at Phoenix, Ariz., on April 22-25 and at Salt Lake City, Utah, on April 28-30. Many witnesses were called before Frank E. Mullen and A. A. Mattson, examiners for the commission, to testify on the possible results of changes in the present freight-rate schedules. Further hearings will be held at Butte and Denver, probably in the latter part of June.

Most of the witnesses stressed the present low prices of metals and the narrow margin of profit on which mining companies were operating as factors that should be considered before revising freight rates upward. In the case of the small mine, making irregular shipments of ore, particularly, they declared that any increase in transportation rates might be fatal. Ira B. Joralemon, mining engineer and geologist, of San Francisco, was one of the principal witnesses at Phoenix. He declared that mining companies of the United States will probably exhaust their known orebodies within 25 to 30 years. He dealt at great length with the uncertainties of mining and the handicaps under which the industry operated in the United States because of the higher standards of living. W. J. Graham, of Phoenix; Ira L. Wright, of Black Hawk Consolidated, in New Mexico; George Jay, purchasing agent of Calumet & Arizona; Gerald Sherman, of Phelps Dodge; P. C. Steinel, of Jerome; and T. C. Foster, state mine inspector of Arizona, were other important witnesses at Phoenix. In all a total of about 50 mining men presented their evidence there.

A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress, testified to the importance of the mining industry to the entire State of Utah in the hearing at Salt Lake City. George H. Dern, Governor of the State, also testified that an increase in mine freight rates would not help the farmers of Utah, since it might deprive them of their best markets. J. W. Wade, of Tintic Standard; Paul Hunt, of Park Utah; Walter Fitch, Sr., of Chief Consolidated; J. A. Norden, of Utah-Apex; A. L. Hurley, of New Quincy; and J. W. Knight were among other witnesses called to the stand. H. W. Prickett, traffic counsel for the Utah chapter of the American Mining Congress, cross-examined most of the mining men.

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GRANBY CONSOLIDATED, operating copper properties in British Columbia, reports profit of $688,386 in the first quarter of 1930, before providing for depreciation, depletion, and taxes.

1929 Lead Output Up 7 Per Cent

Production of refined primary lead in the United States from domestic ore amounted to 672,498 tons, valued at $84,735,000, during 1929, an increase of 7 per cent in production and about 17 per cent in value, according to the U. S. Department of Commerce. The greater percentage of increase in the value was due to the increase in the average selling price of lead.

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Production and Imports of Pyrites Gained in 1929

Production of pyrites in 1929 amounted to 333,465 long tons, valued at $1,250,141, according to the U. S. Bureau of Mines, compared with 312,815 tons, valued at $1,081,758, in 1928, and 302,826 tons, valued at $1,075,644, in 1927. These figures include byproduct pyrite and pyrrhotite concentrates from Tennessee and partly desulphurized tailings from zinc operations in Wisconsin, which have not been included in past, and, consequently, are not comparable with figures reported by the Bureau of Mines for former years. Comparable figures for earlier years will appear in the chapter from *Mineral Resources* in 1929 on sulphur and pyrites.

As in previous years, pyrites was produced in California and Virginia. Because of the obligation to avoid disclosing the outputs of individual producers, the Bureau is not at liberty to show the pyrites production of any particular state.

The quantity of pyrites sold or consumed by producing companies totaled 336,456 tons in 1929, 310,250 tons in 1928, and 293,764 tons in 1927. In 1929, the pyrites produced contained approximately 120,371 tons of sulphur; in 1928, 113,305 tons; and in 1927, 113,406 tons.

Imports of pyrites in 1929 showed an increase of 13 per cent in quantity, following an increase of 82 per cent in 1928, and were 514,336 tons, valued at $1,507,640, compared with 457,123 tons, valued at $1,135,463, in 1928. The imports for 1929 are larger than in any other year since 1917. Of the quantity imported in 1929 Spain furnished 446,093 tons and Canada 68,243 tons.

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Anaconda Wire & Cable

Anaconda Wire & Cable Company has acquired through its subsidiary, Anaconda Wire & Cable Company of California, all the property and assets, except certain accounts receivable amounting to $71,567 and unimproved real property, of California Wire & Cable Company in exchange for 12,000 shares of Anaconda Wire & Cable.

United States Shows Drop in Bauxite Production

Shipments of bauxite from mines in the United States in 1929 were 365,777 long tons, valued at $2,265,638, a decrease of 2.6 per cent in quantity and of 0.4 per cent in total value, as compared with 1928, according to a statement of the U. S. Bureau of Mines.

In Alabama, bauxite was produced in 1929 from the Eufaula and "Lennig" mines, in Barbour County, and the Davis Hill No. 3 mine, in Henry County. The shipments were 70 per cent more than in 1928, of which about half was shipped for use in the abrasive industry and about half for use in the chemical industry.

Bauxite was produced in Georgia in 1929 at the Dupont mine, in Floyd County, and the Lane McMichael mine, in Macon County. Shipments from Georgia in 1929 were 53 per cent less than in 1928, all of which was for use in the chemical industry.

In 1929 bauxite was produced in Arkansas at five mines—the Sweet Home, Dixie No. 2, and Hockstraw mines, in Pulaski County, and the Bauxite and Superior mines, in Saline County. Shipments of bauxite from Arkansas in 1929 were 351,054 long tons, a decrease of 3 per cent from the record for 1928. The main production originated in the Saline County field, in which there was a decrease of 5 per cent, but the mines in Pulaski County shipped important quantities, the increase over 1928 being 8 per cent. The shipments from Arkansas were mainly for use in the aluminum industry, followed in order by the abrasives, chemical, and refractories industries.

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Financial Notes

NEW JERSEY ZINC, operating properties in New Jersey, Virginia, and Colorado, reports a total income of $1,671,867 in the first quarter of 1930, after providing for all charges. Total income was $2,026,934 in the corresponding quarter of 1929.

NORTH LILY MINING, controlled by Anaconda Copper, reports for 1929 a net income of $792,914 from its property in the Tintic district of Utah. Production was 33,168,854 lb. of lead, 790,144 oz. of silver, and 9,414 oz. of gold from 72,889 tons of ore shipped. Gross income was $1,647,108.

AMERICAN SMELTING & REFINING COMPANY'S directors have authorized the sale of $20,000,000 second-preferred 6 per cent stock, now in the treasury, at not less than $100 a share. The stock is callable at $105. Proceeds from the sale of the stock are to be used for acquisition of new properties, mines, expansion of business, and other corporate uses.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74
1927	97.54
1928	99.78
1929	110.33

	1928	1929	1930
January	97.54	106.86	102.94
February	96.73	110.37	102.28
March	96.22	122.71	99.93
April	97.14	116.36	93.24
May	99.05	110.03	....
June	100.16	109.66	....
July	99.69	109.58	....
August	99.85	109.81	....
September	100.53	109.29	....
October	102.34	108.52	....
November	103.83	106.09	....
December	104.28	104.75	....

Issue Bonds for Canadian Copper Refinery

Canadian Copper Refiners, Ltd., is issuing $2,500,000 first-mortgage 6 per cent bonds, due May 1, 1945, to aid in financing the construction of its new plant at East Montreal, Que. In addition, 10,000 shares of stock, of $100 par, is being issued to Noranda Mines, British Metal, and Nichols Copper, the controlling companies. Cost of building the plant is estimated at $3,000,000, so that the present financing would leave a surplus of $500,000 for working capital.

Construction work has already been started and the plant is expected to start by January, 1931. Noranda Mines will provide 50,000 tons of blister copper annually for the plant, and Hudson Bay Mining & Smelting will provide about 15,000 tons annually. The total capacity of the plant will be 75,000 tons annually.

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Slight Drop in Earnings of Hollinger Consolidated

Net profit from operations of Hollinger Consolidated, largest gold producer on the American continent, declined slightly from $3,731,566 in 1928 to $3,638,606 in 1929, largely as a result of decreased gold production. Value of bullion produced was $9,433,767, compared with $10,712,822 produced in 1928. Because of the lower dividend rate, however, the company was able to add $440,606 to surplus, bringing that figure up to $11,110,160.

The company's investments in International Bond & Share, its stock-holding subsidiary, are valued at $11,195,980. Total value of current assets is $12,840,493 and of current liabilities, $436,613.

Improved Call for Copper in English Market

W. A. Doman

London, May 10.—Attempts to analyze the non-ferrous metal situation are apparently futile, as the markets continue disappointing and erratic. The prices are the lowest in many years. On Thursday, May 8, a slight rally occurred in both tin and copper as the result of the cut in prices in the New York market, which stimulated buying. Big interests are reported to be buying copper, after having stayed out of the market for many months. Producers outside the Copper Exporters' organization are raising prices slightly, suggesting that the bottom has been reached.

Anglo-Oriental, the controlling company in a large group of Eastern and African tin mines, announces that a reduction is being effected in its output. Some traders feel that total Eastern stocks are not known, however, and that the tin situation is far from solution. Rumors are spreading that the London banking interests who financed the accumulation of stocks to prevent a drop in the price are finding the continued slump irksome and that they threaten to liquidate their holdings, even though they have been covered to date. Most of their stocks of metal are said to have been acquired when the price of tin was £220 to £230.

Arbitration of the claims of the Soviet government and Lena Goldfields began yesterday. Directors of the Lena company claim that the conditions of the concession were impossible and that that was the reason for withdrawing the staff in spite of protests by the Russians, who blame the concessionaires for the entire dispute.

The Chilean government and the nitrate producers have jointly formed a corporation with a capital of £75,000,000. Half of this will be issued to the government and half to the producers as a purchase consideration for their properties. The total nitrate contained in the properties ceded to the corporation is estimated at 150,000,000 tons, or about fifty years' supply at current rates of production. Export duties will be suspended, the government obtaining, in return, a guarantee that its revenue from the corporation will be not less than £4,500,000 for the first year of operation; £4,000,000 in 1932; and £3,500,000 in 1933. An international agreement of synthetic producers for the limitation of output has been signed in Berlin. The countries concerned will preserve their own national market.

Zinc Corporation, operating a lead-zinc mine at Broken Hill, Australia, has declared a dividend of 2s. 6d. that brings total payments on profits in 1929 up to 3s. 6d., as compared with payments of 4s. in previous years. Further reductions in dividend payments by Broken Hill companies may have to be made as a result of the approaching expiration of the Board of Trade contracts.

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Copper Range Reports Gain

Net income of the Copper Range Company, operating mines in the Michigan copper district, after all charges but depreciation and depletion, was $839,742 in 1929, compared with $727,686 in 1928. The company's total income was $5,575,494, compared with $4,776,600. The company had a surplus of $4,470,164 at the end of 1929, compared with $5,039,454 at the end of 1928. Copper on hand at the end of the year was valued at $581,587, compared with $162,033 at the end of 1928. Production of copper from the three mines in which the company has an interest totaled 12,099 tons in 1929 and 12,127 tons in 1928.

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Anglo-Oriental Cuts Tin Output

Anglo-Oriental Mining Corporation produced 1,246 tons of tin in January, 1,060 tons in February, and 997 tons in March. The output per month for the first quarter of this year, without regulation, was estimated at 1,726 tons. Actual production for the quarter, under control, was 1,101 tons a month.

World's Tin Output

Tin production (mine output) in metric tons, according to the Metallgesellschaft, follows:

Country	Year 1929	Monthly Average 1929	Dec. 1929	Jan. 1930	Feb. 1930
Federated Malay States	68,113	5,676	5,943	6,226	4,844
Unfederated Malay States	2,363	197	194	217	(a) 200
Dutch East Indies	35,513	2,959	3,435	3,516	(b) 2,520
Other countries of Asia	21,307	1,776	1,746	1,952	1,840
Asia	127,296	10,608	11,318	11,911	9,404
Nigeria	10,682	890	780	961	905
Union of South Africa	1,219	102	121	115	(a) 120
Other countries in Africa	(b) 1,298	108	110	120	110
Africa	13,199	1,100	1,011	1,196	1,135
Bolivia	45,211	3,768	(b) 3,500	(b) 4,200	(b) 3,200
America	45,211	3,768	3,500	4,200	3,200
Australia (a)	2,520	210	200	200	200
Europe (a)	5,100	425	425	425	425
Total	193,326	16,111	16,454	17,932	14,364

(a) Estimated. (b) Partly estimated.

Furness Holds Scrap Metal Is Big Price Factor

Large stocks of mineral raw materials, coupled with the lowest level of prices in eight years and an apparent plenitude of money, is an anomaly which suggests to J. W. Furness, chief of the minerals division of the Department of Commerce, that the United States has reached a temporary saturation point in consumption. The present hiatus in demand is attributed by Mr. Furness largely to the uncontrolled return of secondary metals to the market. Experience in copper, lead, and other metals of which a surplus now exists, demonstrates, he says, that a study of the origin, flow, and distribution of secondary metals and their influence on the virgin metals is essential to stabilization of prices.

Mr. Furness contends that in their stabilization programs the producers of virgin metals have not given sufficient weight to the factor that the large initial demand created by new uses tapers off as the supply of recovered secondary metals increases. Though the effect of this reservoir of secondary metal is not always felt immediately, recovery of this metal follows inevitably upon the maintenance of a remunerative price. Eventually, a point is reached where increased total consumption of the metal no longer means an increase in the consumption of the virgin metal.

Citing lead as an example of the importance of the recovery of secondary metal and its influence on the sale of virgin metal, Mr. Furness stated that with the expansion of the automobile and radio industries the lead-mining industry was called upon for ever-increasing amounts until the 95 per cent recoverable from battery grids created such a large secondary supply that in 1929 fully 62 per cent of the 210,000 tons required to satisfy the demand for battery manufacture came from this source.

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Granby Cons. Net Profit Up $1,245,477 in 1929

On the basis of 18c. copper, Granby Consolidated was able to nearly triple its net profit, after all charges, in 1929. The net profit reached a total of $2,021,413, compared with $775,936 in 1928. Operating profit at the mines in British Columbia was $4,337,951, compared with $3,251,227 in the preceding year. Production of copper increased from 57,521,754 lb. to 60,854,591 lb. At the end of the year the company had total current assets of $6,632,463, compared with $5,464,255 in the preceding year and current liabilities of $777,642, compared with $410,295. The company's deficit at the end of the year had been reduced to $1,229,245, compared with $3,250,657 at the end of 1928.

Canada's Mineral Output

Canada's output of copper, lead, zinc, gold, silver, and feldspar in the first two months of the current year showed gains contrasted with the same period last year. Output of asbestos, gypsum, lime, nickel and salt was at a reduced rate in this period. Production figures follow:

	—Two Months Ended— February 1929	1930
Asbestos, tons	40,303	33,229
Cement, bbl	816,389	565,005
Coal, tons	3,235,032	2,815,636
Copper, lb	38,368,668	49,162,977
Feldspar, tons	8,706	10,010
Gold, oz	296,379	299,550
Gypsum, tons	62,283	22,687
Lead, lb	45,306,575	55,091,537
Lime, tons	84,997	78,555
Nickel, lb	18,102,292	16,962,239
Petroleum, bbl	107,899	190,457
Salt, tons	47,089	44,775
Silver, oz	2,704,762	3,551,058
Zinc, lb	32,127,790	38,440,445

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Nevada Con.'s First Quarter

In the first quarter of 1930, Nevada Consolidated made a net profit of $2,224,425 after ordinary taxes and depreciation but before depletion. In the corresponding period of 1929, net profit was $6,724,519. Production in the first quarter of 1930 was 39,699,763 lb. of copper, compared with 55,086,066 lb. in the first quarter of 1929. The cost of producing copper was 9.76c. a pound, compared with 8.28c. a pound in the same period last year. Average recovery of copper from ores increased to 86.35 per cent from 84.84 per cent, and the yield was 20.17 lb. of copper per ton treated, compared with 23.11 lb. in 1929.

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Alaska Juneau in April

In April, 1930, Alaska Juneau mined and trammed to its mill 334,200 tons, from which estimated receipts were $268,000, or 80.19c. per ton. Operating expenditures were $178,000, or 53.26c. per ton, and operating profit $90,000, or 26.83c. per ton. Other expenditures and accrued charges totaled $12,400, leaving to surplus $77,600 for the month. Indebtedness was reduced by $79,376.27 for the month, leaving an unpaid balance of $700,000.

Financial Notes

CALUMET & HECLA CONSOLIDATED, operating in Michigan, reports for the quarter ended March 31 net profit of $1,004,252 after all charges except depletion. In the corresponding quarter of 1929, net profit was $1,800,358.

CHILE COPPER, a subsidiary of Anaconda, has cut its dividend rate from $3.50 paid in 1929 to $3 annually. In 1929, the company also paid an extra dividend of $1.50 a share.

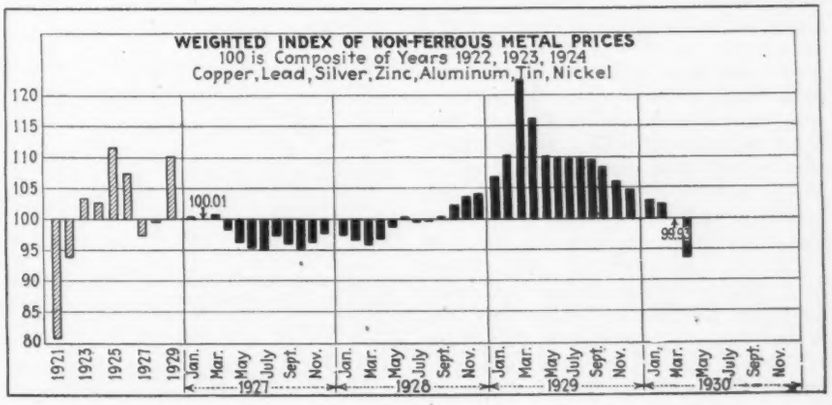
NIPISSING MINING COMPANY, operating in Ontario, made a net profit of $180,009 in 1929. The company's surplus at the end of the year was $3,492,437, compared with $3,702,427 at the end of 1928. Production was valued at $819,310. The company has current assets of $1,700,028 and investments of $1,933,065.

MONTANA MINES, operating a gold property near Helena, Mont., made a net profit before depreciation, depletion, or taxes, of $13,441 in the first quarter of 1930. Production was valued at $60,128. Capacity is being increased, and the management expects a corresponding increase in profits.

LUCKY TIGER-COMBINATION GOLD, operating two silver-gold properties in Mexico, made a net profit, after all charges and additions, of $175,277 in 1929, corresponding with $458,632 in 1928. The company has total assets of $5,172,170 and current and working assets of $1,602,576.

INTERNATIONAL NICKEL reports net profit of $4,616,144 in the first quarter of 1930, compared with $5,590,191 in the first quarter of 1929. These figures include all charges. On March 31, the company reported current assets of $37,649,021 and total assets of $181,576,655. Earned surplus was put at $25,652,762.

AMERICAN POTASH & CHEMICAL, producer of borax and potash salts, reports a net income of $1,348,428, after all charges, in 1929, compared with $1,556,541 in 1928. At the end of 1929, the company's surplus was $2,729,954, compared with $1,909,916 at the end of 1928. Net sales in 1929 were $4,279,600.



Record Tonnage of Copper Sold—Lead Price Advanced 10 Points

New York, May 15, 1930.—A record tonnage of copper was sold during the last two weeks, both to domestic and foreign consumers, but at lower prices. The total quantity of copper sold in this period was in excess of 212,000 tons, with virtually all branches of the consuming industries participating in the business placed. Lead prices were advanced 10 points on excellent buying and firmer markets abroad. The position of zinc underwent scarcely any change, the undertone being rather easy despite the low prices obtaining. Tin made a new low for the movement on selling pressure resulting from the poor statistical showing. Antimony was quiet and quotably unchanged. Quicksilver was in better demand and prices steadied. The situation in platinum appeared to improve on reports of a better understanding among the leading producers.

Buying Wave in Copper

A buying wave of the first magnitude struck the market for copper in the second week of the period under review. In this week the domestic sales reached the huge total of 137,000 tons, the largest for any seven-day period on record. The previous high mark was 102,000 tons for the week ended Sept. 4, 1929. The buying was quite general in character, with the utilities interested in taking on copper and copper products for delivery over the next six months. Sellers, however, did not care to do business much beyond July at current prices. The bulk of the business was placed around 12½c., delivered in the Connecticut Valley. In the last two weeks sales in the domestic market were recorded at prices ranging from 12c. to 13c. per pound, delivered in the East, with the high figure prevailing in nearly all quarters toward the close.

Export demand was brisk on the decline in price, and upward of 60,000 long tons of copper were sold to foreign buyers in the first half of May. Total sales for export during April amounted to 43,500 long tons. Copper Exporters advanced from 12.80c. to 13.30c., c.i.f. usual European ports, on May 12.

The unfavorable April statistics—an increase of 45,318 tons in stocks of refined copper in the hands of North and South American producers—had little influence on the situation. The heavy buying is expected to mark the turning point for producers.

Good Sales of Lead

The activity in copper was reflected in a greatly increased demand for lead. Cable makers, whose business improved on account of the severe cut in copper prices, purchased a large tonnage. Almost 9,000 tons of lead was reported sold in the week ended May 14, this being the biggest week in eight months. Foreign sales also were much better. The price held at 5.50c., New York, and 5.40c., St. Louis, until May 15, when the American Smelting & Refining Company, influenced by the activity here and the upward trend in London, advanced its contract price to 5.60c., New York. The principal Mid-Western seller, however, advanced his price only 5 points, to 5.45c., St. Louis, as the low differential between the two markets has been an adverse influence on the selling of Missouri lead in the East.

Zinc Unsettled

Stocks of zinc in the United States on May 1, according to the American Zinc Institute, totaled 96,453 tons, against 94,033 tons a month previous. Shipments during April were small, totaling 40,660 tons, against 44,245 tons in March. Demand for zinc has improved slightly since the first of the month, but this resulted in no change in the price trend. Prime Western zinc sold down to 4.60c., East St. Louis, a new low for the movement. The price has reached a point where several sellers have decided to hold on to their supplies for higher values. A discouraging development toward the close was the continued weakness in the London market, where the price of spot zinc fell to £16 10s.

Tin Makes New Low

Tin touched a new low for the current movement. On May 9 Straits tin was quoted at 31¾c. for prompt shipment, the lowest price since 1922, when 28¾c. was reached. Good buying developed at the lower prices, especially for early shipment to consumers. The activity in copper and lead was to some degree responsible for the buying interest in tin. In London the market met with some support from the group. The world's visible supply of tin on May 1 was estimated at 36,595 tons, a gain of more than 3,500 tons over the April 1 total, and about 10,000 tons greater than on May 1, 1929.

Silver Easier

The silver market has declined about 1⅛c.in the last two weeks, owing to weakness in China exchanges, resulting in heavy sales of the metal from that quarter. Despite the unsettlement in the Indian political situation, the purchases there were on a scale large enough to lend some support to the market.

Zinc Concentrate Down

The Joplin, Mo., market for zinc concentrate was lowered $2 per ton, establishing the quotation for Prime Western, basis 60 per cent, at $33. Fines and slimes, basis 60 per cent, settled at $32 per ton. Galena, basis 80 per cent lead, held at $62.50 per ton.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c. London, 98 per cent, quoted at £95 per long ton, less 2 per cent for domestic consumption.

ANTIMONY—Per lb., duty paid: Chinese brands, spot, 7½c.; futures, 5½c., in bond. Cookson's "C" grade, spot, 12⅞c. "C.M.C." grade, spot, 11¼c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c.

BISMUTH—Per lb., in ton lots, $1.20. Smaller lots $1.35 and up. London 5s.

CADMIUM—Per lb., 70@75c. London 3s. 11d.@4s. for prompt.

Mining Company Dividends and Yields for May, 1930

Companies in the United States	Situation	Per Share	Total Disbursements	Annual Per Cent Yield
American Smelting & Refining	Various	$1.00 Q	$1,829,940	5.5 j
Anaconda Copper, c, z, l, s	Various	1.75 Q	15,449,100	11.2 j
Bethlehem Steel Corp	Various	1.50 Q	3,604,350	6.1 j
Bunker Hill & Sullivan, l, s	Idaho	0.50 MX	163,500	10.8 j
Colorado Fuel & Iron	Various	0.50 Q	171,178	3.2
Colorado Fuel & Iron, pfd	Various	2.00 Q	40,000	....
Freeport Texas Sulphur	Texas	1.00 Q	729,783	10.0 j
Homestake Mining, g	S. Dakota	0.50 M	125,580	9.0 j
Miami Copper	Arizona	1.00 Q	747,134	18.1 j
Mohawk Mining, l, s	Michigan	1.50 Q	172,500	....
National Lead "B"	Various	1.50 Q	154,913	5.0 j
New Jersey Zinc	Various	0.50 Q	981,632	3.2 j
United States Steel, pfd	Various	1.75 Q	7,214,920	4.8 j
United Verde Extension, c	Arizona	1.00 Q	1,050,000	33.3 j
Vanadium Corp. of Am	Various	0.75 Q	283,775	2.6 j
Companies in Other Countries				
Andes Copper	Chile	0.75 Q	2,320,000	11.5 j
Cerro de Pasco, c, s	Peru	1.50 Q	1,684,263	10.3 j
Granby Consolidated, c	Canada	2.00 Q	900,000	22.8 j
Hollinger Consolidated Gold	Canada	0.05 M	246,000	9.6 j
International Nickel, pfd., c, n	Canada	1.75 Q	158,959	5.8 j
Teck-Hughes, g	Canada	0.15 Q	713,574	9.0 j
Total			$38,741,101	

c, copper; z, zinc; l, lead; s, silver; g, gold; n, nickel; Q, quarterly; MX, monthly and extra; M, monthly; j, based on dividends for last 12 months.

Daily Prices of Metals

May	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
1	13.775	33.375	5.50	5.35@5.40	4.70
2	13.775	33.25	5.50	5.35@5.40	4.70
3	13.775	33.50	5.50	5.35@5.40	4.70
5	12.825	32.375	5.50	5.40	4.65
6	12.275	32.125	5.50	5.40	4.65
7	12.075	32.375	5.50	5.40	4.65
Av'ge	13.083	32.833	5.500	5.388	4.675
8	12.025@12.275	32.25	5.50	5.40	4.60
9	12.200	31.75	5.50	5.40	4.60@4.625
10	12.275	31.875	5.50	5.40	4.60@4.625
12	12.450	32.375	5.50	5.40	4.60@4.65
13	12.700	33.00	5.60	5.45	4.60@4.65
14	12.725@12.775	33.125	5.60	5.45	4.60
Av'ge	12.421	32.396	5.533	5.417	4.613

Average prices for calendar week ended May 3, 1930, are: Copper 13.775c.; Straits tin, 33.854c.; New York lead, 5.500c.; St. Louis lead, 5.379c.; zinc, 4.706c.; and silver, 42.333c.

Average prices for calendar week ended May 10, 1930, are: Copper, 12.300c.; Straits tin, 32.125c.; New York lead, 5.500c.; St. Louis lead, 5.400c.; zinc, 4.629c.; and silver 42.063c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
1	4.85 3/4	42 1/4	19 1/2	84s11 d	8	4.85 5/8	42 1/4	19 1/2	84s11 1/2d
2	4.85 7/8	42 1/8	19 3/8	84s11 1/2d	9	4.85 9/16	41 7/8	19 3/8	84s11 1/4d
3	4.85 3/4	42 1/4	19 1/2	.....	10	4.85 5/8	41 1/2	19 5/16	.....
5	4.85 13/16	42 1/2	19 9/16	84s11 1/2d	12	4.85 5/8	41 5/8	19 1/4	84s11 3/8d
6	4.85 7/8	42 1/4	19 1/2	84s11 1/2d	13	4.85 5/8	41 1/2	19 3/16	84s11 3/8d
7	4.85 5/8	42	19 7/16	84s11 1/2d	14	4.85 11/16	41 1/8	19 1/16	84s11 3/8d

Average of week ended May 7: Silver, 42.229c.; Sterling Exchange, $4.85781.
Average for week ended May 14: Silver, 41.583c.; Sterling Exchange, $4.85625.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command five-thirty-seconds cent premium.

London

May	Copper Standard		Electrolytic Spot	Tin		Lead		Zinc	
	Spot	3 M		Spot	3M	Spot	3M	Spot	3M
1	50 3/4	50 3/8	60	151 1/2	153 1/2	17 7/16	17 1/2	16 5/8	17 1/4
2	51	50 3/8	60	150 1/4	152 3/8	17 1/4	17 3/8	16 3/8	17 1/16
5	49 1/2	49 1/2	59	148 3/4	150 3/4	17	17 1/8	16 1/4	16 15/16
6	48 1/2	48 3/8	58	142 3/8	144 1/4	17 1/16	17 1/8	16	16 5/8
7	48 3/8	48 1/8	56	145 1/4	147	17 1/4	17 3/8	16 1/8	16 7/8
8	49 7/8	49 3/8	57	145 1/2	147 1/8	17 1/2	17 9/16	16 7/16	17 1/8
9	51 1/4	51 3/16	57	145 1/2	146 5/8	18	18 1/16	16 15/16	17 5/8
12	55 5/8	54 3/8	58 1/2	145 3/8	147 1/4	18 3/8	18 3/8	17 5/8	18 1/4
13	57 7/8	57 3/8	60	150 1/2	151 3/4	18 1/2	18 1/2	17 1/8	17 3/4
14	56 1/4	55 3/8	60	149 3/8	150 5/8	18 1/4	18 1/4	16 1/2	17 1/8

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

MAGNESIUM — Per lb., 12-lb. ingots (4x4x16 in.), 65c.@$1, depending on quantity; 2½- or 3-lb. sticks (1⅛ in.), 70c.@$1.05, depending on quantity. London, 3s. 3d.@3s. 6d. for 99 per cent ingots or sticks.

MOLYBDENUM—Per lb. in 50- to 100-lb. lots, 99 per cent, $11; 97 per cent, $9. (Usually sold as calcium molybdate or ferromolybdenum, which see.)

NICKEL—Per lb., ingot, 35c.; shot 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. London, per long ton, £170@£175.

OSMIUM—Per oz., $65@$70; nominal. London, £13 15s.

PALLADIUM—Per oz., $25@$27; London, £5 5s.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $46. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

London, per oz., £9 5s. for refined; crude and scrap, nominal at £7 15s.

QUICKSILVER—Per 76-lb. flask, $116 @$117. Market has been more active and prices are firm. London quiet, with offers at £22 15s.

RADIUM—Per mg. radium content, $70.

RHODIUM—Per oz., $45@$50. Nominal. London, £11@£12.

RUTHENIUM — Per oz., $40@$45. Nominal. London, £9 10s.

SELENIUM—Per lb. in 500-lb. lots: Black, powdered, amorphous, 99.5 per cent pure, $2. London, 7s. 8d.@ 7s. 9d.

TANTALUM—Per kilo: Heavy sheet, chemically pure, $128; bars, $145; tantalum powder, c.p., $69.35.

TELLURIUM—Per oz., 15@18c.

THALLIUM METAL—$12.50@$15 per pound.

TITANIUM—Per lb., 80@90 per cent grade, $5.

TUNGSTEN POWDER—Containing 98 per cent tungsten, per lb., $1.70.

Metallic Ores

ANTIMONY ORE—Bolivian ore, 60 per cent metallic antimony, $1.30 per short ton unit, c.i.f. New York.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $21.50 for 46@47 per cent Cr_2O_3 ore, and $24 for 50@51 per cent ore. New Caledonian ore, high-grade, $24.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.65.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 9c.

Foreign ores, alongside docks Atlantic ports, cargo lots, cents per unit:

North African, low-phosphorus, 12c.

Spanish and North African basic, 55@60 per cent, 10½c. Nominal.

Swedish foundry or basic, 66@68 per cent, 10½c.

Newfoundland foundry, 55 per cent, 8½@9c. Nominal.

MANGANESE ORE—Per long-ton unit of Mn, c.i.f. North Atlantic ports, cargo lots. Exclusive of duty: Brazilian, 46@48 per cent Mn, 28@29c.; Indian, 48@50 per cent, 30@31c. Caucasian, 52@55 per cent, 30@31c.; Cuban, minimum 47 per cent, 32c.; Chilean, 47 per cent, minimum, 31c.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, minimum 80 per cent MnO_2, Brazilian or Cuban, $60. Javan or Caucasian, 85 per cent minimum, $65. Domestic, 70 to 72 per cent, $40@$50, f.o.b. mines.

TANTALUM ORE—Per unit of Ta_2O_5, basis 60 per cent ore, $13, nominal.

TITANIUM ORE—Ilmenite, per gross ton, 50 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c. in carload lots.

TUNGSTEN ORE—Per short ton unit of WO_3, N. Y.: Wolframite, $14 for future delivery. Market quiet. Bolivian scheelite is quoted at $14.50, May-June shipment. Domestic scheelite, $16, nominal.

VANADIUM ORE—Per lb. V_2O_5 contained, 28c.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE — Per ton, f.o.b. mines, 8@9 per cent lithium oxide, $30@$60.

ASBESTOS—Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading sellers for delivery on contract:

Crude No. 1, $475@$575; crude No. 2, $325@$375; spinning fibers, $150@$175; magnesia and compressed sheet fibers, $100@$135; shingle stock, $50@$85, various grades; paper stock, $35@$40; cement stock, $15@$25; short fibers, $10@$15; floats, $12@$15.

Per ton c.i.f. New York: Rhodesian crude No. 1, $400; No. 2, $325.

BARIUM CARBONATE (Witherite)—Per ton: 90 per cent, 200 mesh, $47; 100 mesh, $44.

BARYTES—Per ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude (per long ton), $6.50. Washed and water floated to 97 per cent through 325 mesh, $18.

Missouri: Water ground and floated, bleached, $23, car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7.75@$8, f.o.b. mines.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7.25@$8.25, f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.75@$8.25, f.o.b. *Arkansas* mines. Pulverized and dried, $12@$13, f.o.b. *Arkansas* mines; calcined, 78 to 84 per cent Al_2O_3, $18@$19, f.o.b. *Arkansas* mines.

Per metric ton, foreign, c.i.f. Atlantic port: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50; Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 5 per cent SiO_2, $6@$8.

BORAX—Per lb.: Carload lots, in bags, crystals, 2¼c.; granulated or powdered, 2½c.; f.o.b. shipping point.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $6; crude No. 2, $5; washed, $8; powdered and air-floated, $8@$12; ground, $7@$15.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour in 100-lb. bags (bags extra), No. 1, $20; No. 2, $17.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots.

Imported English, f.o.b. American ports; lump, $14@$20; powdered, $40@$45.

DIATOMITE—Per short ton, f.o.b. producing plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in., $18@$20; air-floated powder, $45; 80 to 85 per cent silica, 98 per cent through 200 mesh, $20 in carload lots.

EMERY—F.o.b. *Pennsylvania* and *New York,* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 6½c.; domestic, 3½c.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $6.50@$8; No. 2, glass grades, $5.50@$6.

No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 20 mesh, $10.25@$12; 140 mesh, $13.50@$16; 200 mesh, $15@$18; all per short ton.

New Hampshire, per ton: Pottery grade, $8. Best quality lump, $8.50.

New York, per ton: f.o.b. cars, No. 1 crude, $9. Soda feldspar, 140 mesh, first grade, $16 per short ton; 200 mesh, first grade, $18.

Maine, per ton: Best pottery grade, ground, $19.

FLUORSPAR — Per ton: F.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $28 in car lots.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16; 94 lump, $21; ground, 97, $35.

Foreign spar, duty paid, $17, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 16 to 60 mesh, $17; 60 to 90 mesh, $14; 100 mesh up, $7.

Powdered, import duty paid, $24@$26 per ton.

GARNET — Per ton: domestic, f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry:

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50.

GRAPHITE—Per lb., f.o.b. *New York:*

Ceylon lump, 8@9c.; chip, 6½@7½c.; dust, 3@5c.; Madagascar flake, 6@7c.

No. 1 flake, 8@16c.; fine ground, 3@14c. Ordinary fine ground, 3@5c.; high grade, 8@12c.; amorphous, 3@7c.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $1.50@$5; ground, $4@$9; agricultural, $4@$8; calcined, $4@$13.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

[1]Price furnished by Foote Mineral Company, Philadelphia.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 50c.@$3.

Agricultural, 75c. up to $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A," calcined, 80 per cent through 200 mesh, $43; Grade "B," $40; dead-burned, $29; crude, $11. *Washington:* Dead-burned magnesite, $22 per ton, Chewelah, Wash.

MICA—Per ton, f.o.b. plant:

New Hampshire: Mine-run sheet and punch, $320@$340; clean shop scrap, $20@$25; roofing, $21.50@$25. White dry ground, 20 mesh, $25; 40 mesh, $35; 60 mesh, white, $39; 100 mesh, $45; 200 mesh, $60. Granite mica facings for cement block and stucco use, $8@$12, depending on size between ¼ in. and 60 mesh. Disks, 1¼ in. No. 1, per lb., $1.25; 2½x2 in. square cuts, $3.25.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, per lb., f.o.b. *New York*, duty paid: No. A1, $2.50; No. 1, $2; No. 2, $1.65; No. 3, $1.15; No. 4, 60c.; No. 5, 45c.

MONAZITE—Per ton (Minimum 6 per cent ThO_2): $60.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent, $6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4. Dull.

Tennessee, ground, 80 per cent through 300 mesh, 33 per cent P_2O_5, $11.80 per short ton.

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur; c.i.f. United States ports; guaranteed 48 per cent sulphur: Spanish, 13c.; Tharsis, furnace size, 2½ in. diameter, 14c. Cinder from ore to remain property of buyers.

QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. Flawless, for optical purposes, four times above price; larger crystals still higher.

SILICA—per ton: Water ground and floated, in bags, f.o.b. Illinois: 325 mesh, $18@$40 for 92 to 99½ per cent grades. Market steady. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35 @$3.50.

SPODUMENE — Per ton: $20@$30, depending upon lithium content.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports.

TALC—Per ton, carload lots, f.o.b. works, containers included unless otherwise specified:

Vermont: 99 per cent through 200 mesh, extra white, bulk basis, $8@$8.50; 97 to 98 per cent through 200 mesh, medium white, $7.50@$8.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75.

Georgia: Powdered, gray, $7.50@ $10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9.

New Jersey: Soapstone, ground, $10 @$12.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $16. Double ground through 110 mesh, rose and cream, $18. Air-floated through 200 mesh, rose and cream, $27.50; mill run, $16. Demand quiet.

Rolled Metals

COPPER — Sheets, hot-rolled, per lb., 22¾c.; wire, per lb., f.o.b. mill, 15½c.

LEAD SHEETS—Full rolled, 8¼c. per lb.; clipped, 8½c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

ZINC SHEETS—Per lb., 10c., f.o.b. works. Strip, 9½c.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces: Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per 100 lb., $1.80@$1.85.

COKE—Per gross ton, Connellsville furnace, $2.60@$2.65. Connellsville foundry, $3.50@$4.80. Byproduct coke, Ohio and Kentucky (Connellsville basis), $6.50; Buffalo and Detroit, $8.50@$9.

Metallic Compounds

ANTIMONY OXIDE—White, Chinese, 99 per cent Sb_2O_3, 10½@11c. per lb. Nominal.

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. Good demand from insecticide trade and prices are steady. London, per long ton, £15¾@£16 for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 95c.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 4½@5c. for either large or small crystals.

SODIUM NITRATE—Per 100 lb.; crude natural, in bags ex vessel, Atlantic ports, $2.16 for May deliveries.

SODIUM SULPHATE (Salt Cake)—Per ton, bags, f.o.b. works, $22@$23; in barrels, $25@$28.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35 @$38.

MAGNESITE—Brick, per net ton, f.o.b. works: 9-in. straights, $65, f.o.b. plant. Cement, $40, seaboard.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio,* $43; *Alabama,* $51; *Illinois,* $52.

ZIRKITE—Per lb.: Powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Alloys

FERROCERIUM—Per lb., $6 in 100-lb. lots.

FERROCHROME—Per lb. of contained chromium, 4 to 6 per cent carbon, 11c. on requirement contracts; spot shipments, 11½c. Maximum 2 per cent carbon, 17½c., contracts. Freight allowed on carload lots east of Mississippi River and north of Baltimore.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $94@$99. Spiegeleisen, 19@21 per cent, $34 on carload business, f.o.b. furnace.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.20.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50, f.o.b. *Alabama* and *Tennessee.*

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River and north of Baltimore: 50 per cent, $83.50; 75 per cent, $130; 15@17 per cent, $45, f.o.b. Suspension Bridge, N. Y. Quotations for spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton: $160, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.45 f.o.b. works.

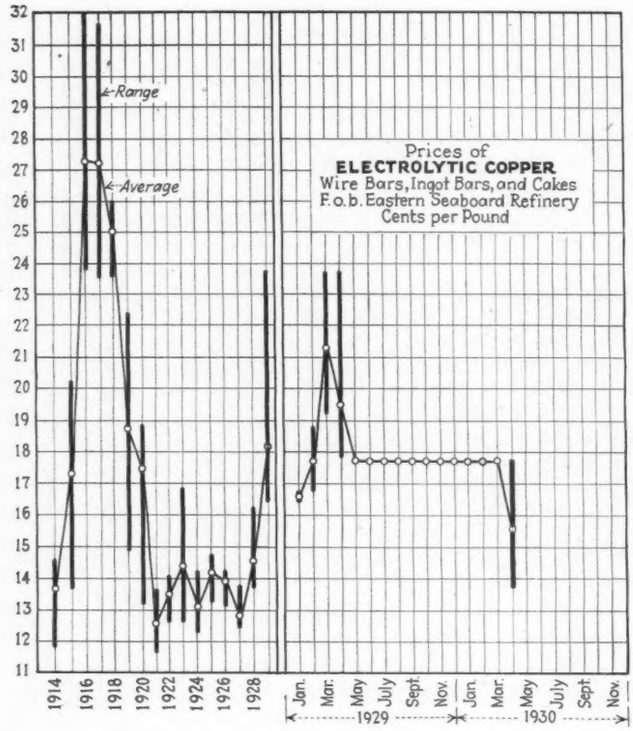
FERROVANADIUM—Per lb. of V contained, f.o.b. works, freight allowed east of Mississippi, $3.15@$3.50, depending on grade and quantity.

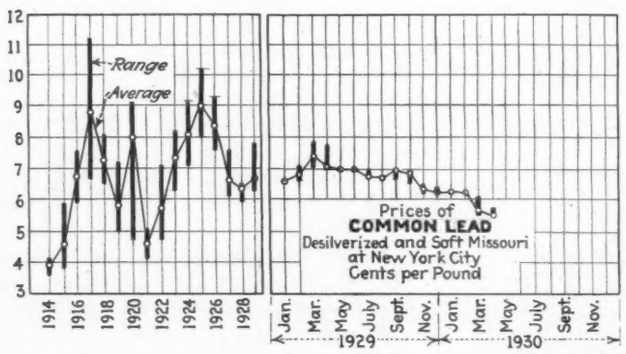
NICKEL SILVER—Rods or wire, per lb., 18 or 20 per cent nickel, Grade "A," 37¾c.; sheets, 30¾c.; retroactive to May 13.

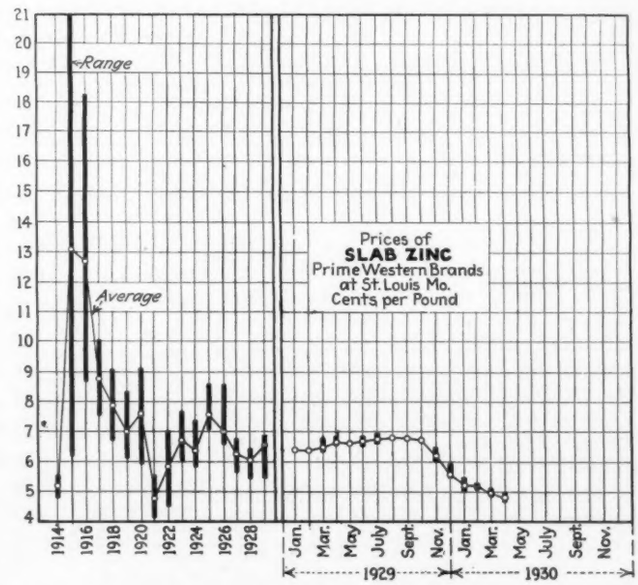
MUNTZ METAL—Rods, 19c.; plates, 21¾c.; retroactive to May 13.

PHOSPHOR BRONZE — Grade "A," 5 per cent tin, sheets and rods, 34c.; wire, 34½c.

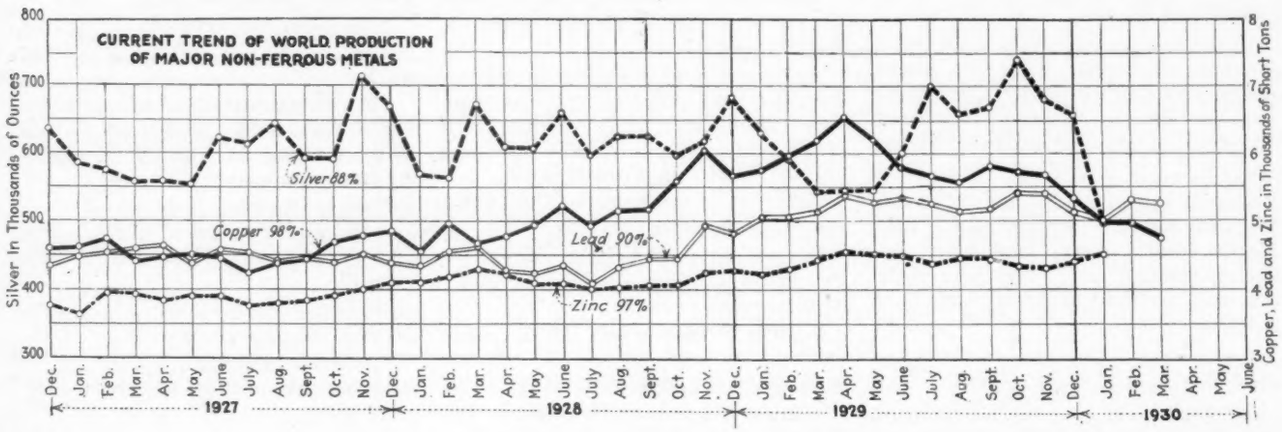
Metal Price Curves


Range
Average
Prices of
ELECTROLYTIC COPPER
Wire Bars, Ingot Bars, and Cakes
F.o.b. Eastern Seaboard Refinery
Cents per Pound
1914 1916 1918 1920 1922 1924 1926 1928
Jan. Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov.
1929 1930





THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926, and accordingly the horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Silver in Thousands of Ounces
Copper, Lead and Zinc in Thousands of Short Tons
Silver 88%
Copper 98%
Lead 90%
Zinc 97%
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June
1927 1928 1929 1930